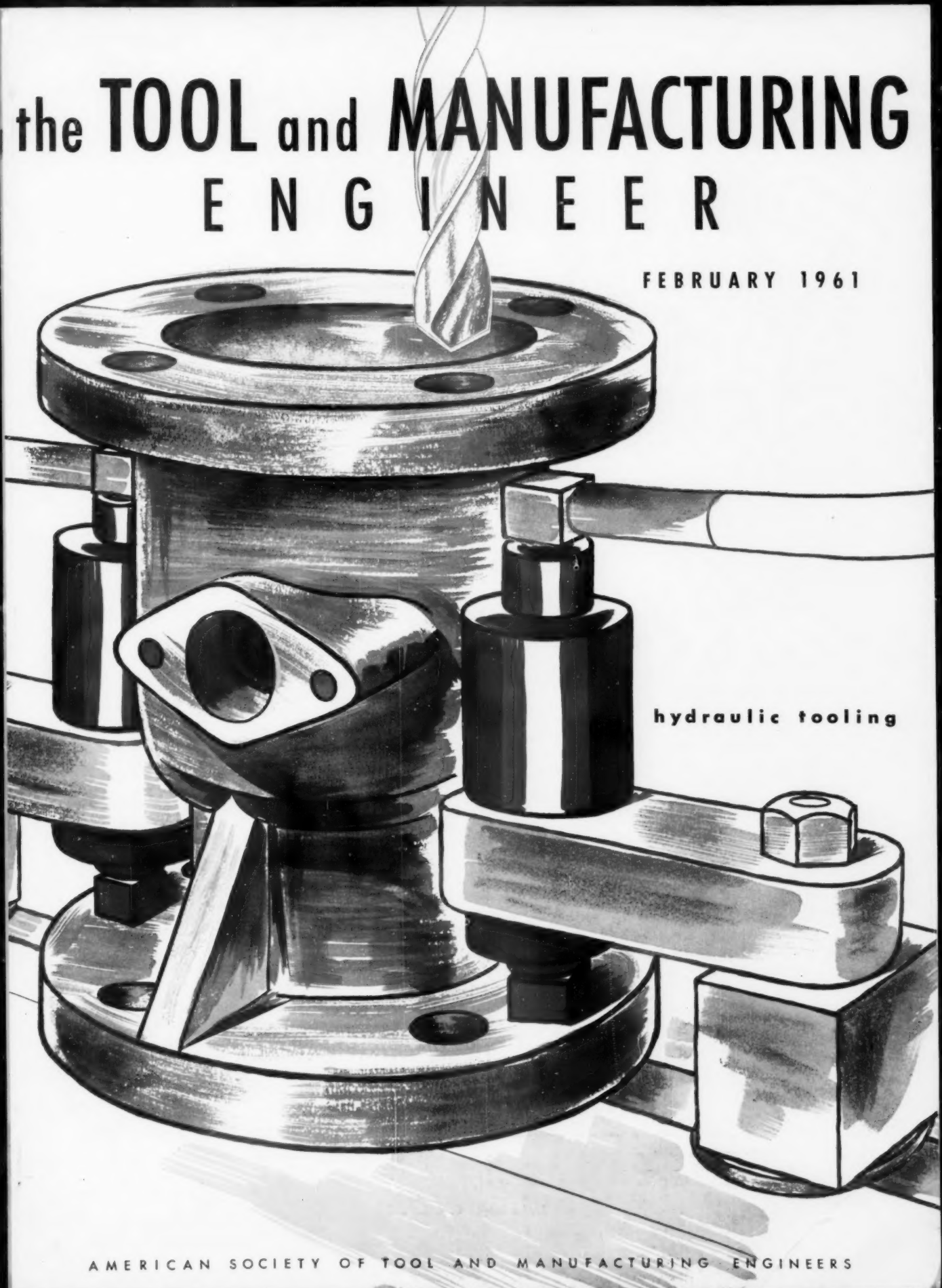
the TOOL and MANUFACTURING ENGINEER

FEBRUARY 1961



hydraulic tooling

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS

UNIVERSAL GRINDING

Reversing the Cost Trend

by Clifford G. Menard
Consulting Engineer
The Heald Machine Company

Just about everything costs *more* these days—*much* more than it did 10 or 15 years ago. And when we first decided to build a completely new Universal Internal Grinding Machine that would not only "hold the line", but actually *reverse* the upward cost trend, many an eyebrow was lifted in disbelief. Some said it couldn't be done. Others felt that major economies could be made only with a big sacrifice in performance.

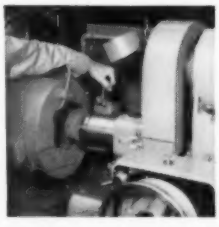
Admittedly, the task was not a simple one. In order to cut costs without cutting quality, we had to make a complete re-evaluation not only of the basic machine design, but of every step of our manufacturing operations as well. But we found that a large number of cost savings could be made, by utilizing the latest advances in machine design and streamlining production methods to eliminate as many manual operations as possible. Although most of the savings were relatively small individually, they added up to a major reduction in manufacturing cost.

This better, more versatile general purpose grinder costs about *half* as much as comparable machines today, and *less* than similar machines (with fewer features) cost in 1947!

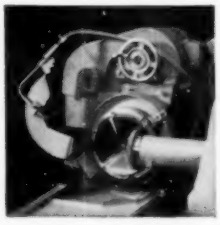
Here's how some of the savings were made. The use of hydrostatic table ways eliminated an expensive booster arrangement in the hand table feed. An externally-mounted valve "package", on the front of the machine, simplified the hydraulic power arrangement and eliminated all but essential units in the hydraulic system. And with all hydraulics outside of the machine, the base is mechanically stronger and less expensive to produce because there are fewer holes and less surface area to finish. Furthermore, simplified basic engineering and construction make it possible to build this standard machine with standard arrangement on a STOCK basis resulting in shorter deliveries.

These and other refinements enabled us to make the 273A a truly universal machine with greater capacity, easier operation, and inherent precision that holds tolerances within .0001″ in normal production and .000050″ in special cases. Yet its 1947 price tag puts it within the economic reach of virtually every plant or machine shop, regardless of size.

Here's the new Model 273A Universal, on display at the 1960 Machine Tool Exposition. On a steel test piece, the O.D., a straight bore, a tapered bore and the face were ground to size within .0001″ at a single chucking.



Workhead swivel of 90°, several wheelhead positions, permit I.D., O.D. and rotary surface grinding of parts up to 12″ in diameter. Vari-speed workhead drive is infinitely adjustable from 75 to 450 rpm.



Ask your Heald Engineer for the complete UNIVERSAL story. Then compare its performance and cost with any other similar machine available today!

THE HEALD MACHINE COMPANY
Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

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the TOOL and MANUFACTURING ENGINEER

Volume 46
No. 2

February
1961

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By simulating production runs on a computer, it is possible to determine plant efficiency before machines are ordered.

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Polishing Carbide Dies with Diamond Belts.....*By John Stangeby* 85

Die refinishing, once a manual operation, is now being performed by machine, with greater accuracy and productivity.

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Low-voltage resistance heating is a desirable method for heating large forming platens, beaded-panel dies and insert form tools.

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Positional tolerancing reduces manufacturing costs by preventing functionally satisfactory parts from being rejected by inspectors.

Reduced Costs Sighted through Optical Tooling.....*By John M. Miller* 103

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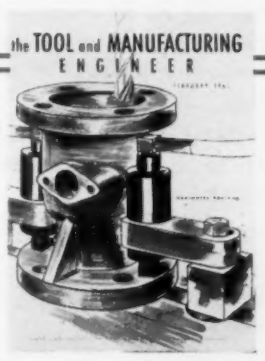
THIS MONTH'S COVER

Over-all machine productivity is dependent on many variables—feeds, speeds and cutting materials to name a few. Often an improvement in clamping methods results in major increases in efficiency. One approach to greater clamping efficiency—the use of hydraulic clamps—is shown here. Applications of these clamps are discussed in an engineering article starting on page 79.



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Profit By Mistakes!

A famous research engineer once said that there is more valuable information in his company's scrap pile than an engineer could analyze and apply usefully in a lifetime. This applies to manufacturing engineers as well as to design engineers.

Parts scrapped because they are out of tolerance need not necessarily be due to faulty processing. Impractical design could well be the culprit. To make the best of a bad situation, manufacturing frequently attempts to produce economically by using questionable methods instead of insisting on redesign. The scrap pile, however, holds the undisputed facts if the engineer wou'd only consult it.

Scrap can lead the way to countless other causes of trouble including faulty specifications, inferior material, improper heat treat, or inadequate machines and processing equipment to say nothing of the ever-present human factor. In a cost-reduction program, each contribution to scrap is worthy of analysis. Corrections, possibly of a minor nature, may effect tremendous savings.

In the area of automation, experience is invaluable. The economic fault of overmechanization is probably more hazardous than that of insufficient mechanization. Either should be detected early to ensure profitable operations. Corrective measures for the former, however, can be heartbreaking, because they may involve discarding expensive equipment.

Overmechanization might be exemplified by an automatic assembly line wherein processing operations are performed at or between assembly stations. Such a line can operate only as fast as the slowest function whether it be an assembly or machining operation. If machine tools, punch presses or molding machines are involved, costly and uneconomical machine utilization may result.

With information gained from experience and reported data, the engineer can apply the best known methods without economic waste and for the benefit of all.

John W Greve

EDITOR

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preview

. . . a fast look at this issue

Computers for Plant Planning? 71

Short lead time and rising costs make it physically and economically impossible to try out alternative production systems under actual plant conditions.

Using a computer, General Electric manufacturing engineers simulate planned production lines. In the computer model, parts are processed on machines, travel from machine to machine, line up at bottleneck machines, and wait for labor and each other just as they do in actual production.

Computer simulation of production lines makes it possible to gain experience equivalent to weeks or months of actual operation in a few minutes. Costly mistakes are avoided and proposed manufacturing systems can be quickly and inexpensively evaluated.

Hydraulic Clamping 79

Although hydraulic clamping of parts for machining has been in use for many years, until recently it has been restricted to applications where production volumes are high and the initial cost of the hydraulic equipment can be amortized over many pieces.

Today, with the advent of compact, self-contained hydraulic systems that are designed primarily for tooling purposes, it is feasible to use hydraulic clamping for short-run production. The advantages are faster, more uniform and more reliable clamping.

High-Production Gun Drilling 83

In the gun drilling process, deep (usually blind) holes are drilled with high speed and precision. These characteristics of the process have made it a natural choice for hole finishing operations in the cylinder heads for Diesel engines. The heads are produced on versatile transfer machines that can accommodate several different part sizes and configurations.

Finishing Carbides with Diamonds 85

Hand refinishing of round-core carbide draw and extrusion dies may be on its way out. Machines using diamond belts are capable of extremely fast operation and a higher degree of precision than is possible with conventional manual operations.

Resistance-Heated Dies 94

Many Space-Age materials must be hot-formed to eliminate springback and cracking. Of the die-heating methods that have been tested, low-voltage resistance heating seems the most promising. Large quantities of electrical insulation—which also acts as heat insulation—are not required, so die temperatures are closer to the temperature of the heating element. The ease with which heating can be controlled in a low-voltage system is an added advantage.

Positional Tolerancing 98

Positional tolerancing, a method of dimensioning in which the functional characteristics of a part are taken into account during inspection, simplifies the reworking required to make an out-of-tolerance part into an acceptable part. The positional tolerancing system is quickly learned by designers and inspectors.

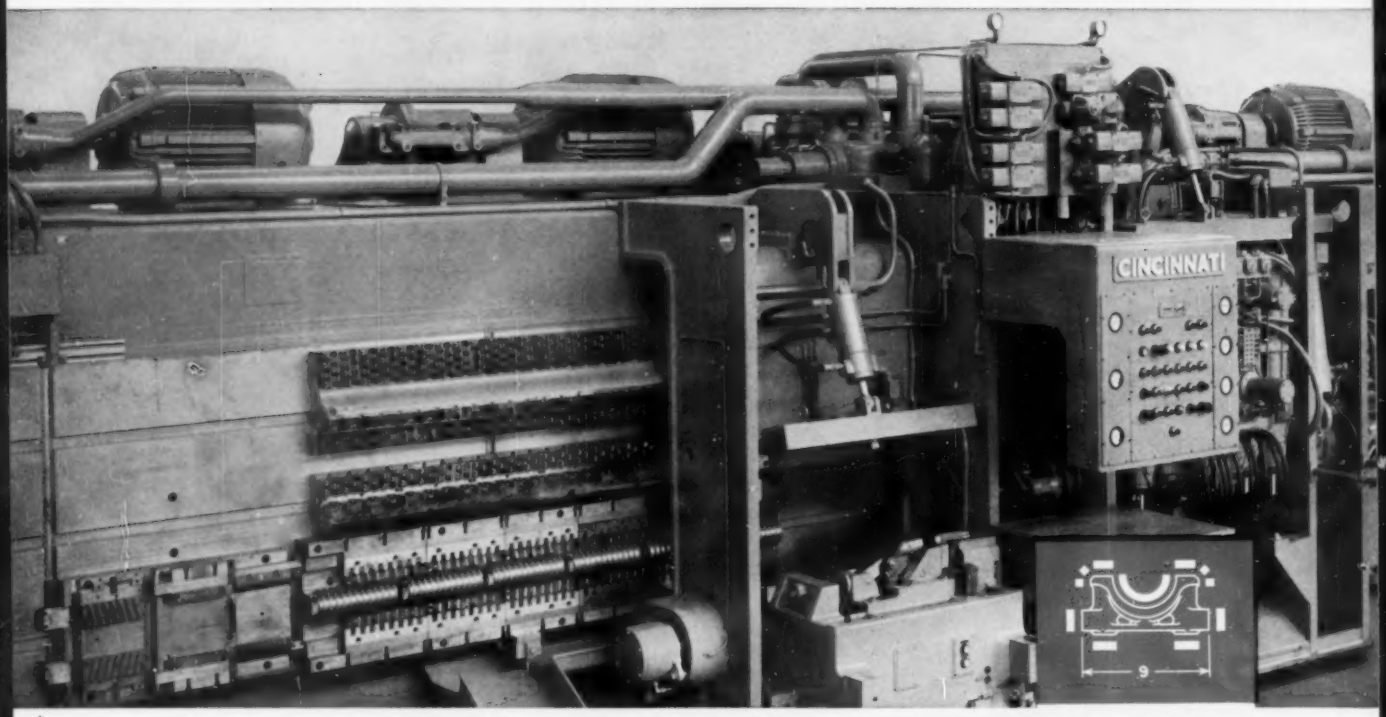
Optical Tooling Lowers Manufacturing Costs 103

Although optical tooling was originally adopted because it satisfies the need for extremely precise measurements, it also provides a means for effecting major manufacturing cost savings, particularly in the fabrication of parts and assemblies that require long-range measurement and alignment. Using optical alignment, it is possible to machine large parts on small machines, instead of the large machines normally used. This can make small plants competitive with large plants and substantially reduce capital investment costs.

CINCINNATI

CINCINNATI Surface Broaching Specialists consider everything . . . Including

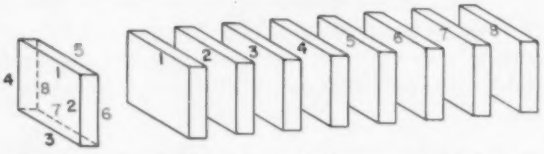
Throw-away Tool Bits



Thirteen sizes of main bearing caps are surface broached on this CINCINNATI Horizontal Hydro-Broach Machine. Throw-away tool bits are indexed every 24,000 to 29,000 parts, and eight cutting edges are used, keeping costs at a minimum. Production, 80 parts per 48 minute hour. Catalog M-1910.

How will broaching stack up against milling or other machining methods? Cincinnati Milling's Engineering Service Specialists can give you the answer. How will *throw-away tool bits* stack up against those requiring resharpening? These Specialists can answer that too, because they consider every facet of machining cost. Throw-away tool bits for broaching*, a new idea offering substantial cost reduction, was one of the considerations in tooling up the Horizontal Hydro-Broach Machine illustrated above.

Through an ingenious tool holder arrangement, developed by Cincinnati Milling's Special Machine Division, throw-aways are used eight times before discarding. Let's assume that we have sintered carbide bits. Using only one cutting edge, 20,000 or more parts can be broached. The bits are unclamped, turned 90° and the second edge is available to broach another 20,000 parts, and so on. Both sides of the bit are used (negative rake angle). Then there are eight cutting edges, as indicated in the drawing below.



The throw-away idea is a typical example of the advanced thinking and modern approach to low-cost production which Cincinnati's Special Machine Division imparts to broaching machines, production lines and every type of equipment built to your requirements. May we send you more information? **Special Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

*Patent pending.

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

For the first time in history, man has made large diamonds. This development comes just five years after the production of the first man-made diamonds by General Electric. GE can now make, in the laboratory, diamonds up to 1/10th carat in size that are of excellent industrial quality. These are not yet commercially available. Stones of this size are used for metal-bonded diamond wheels and saws.

Diamonds in full-carat sizes are also being made by GE. If the company can perfect the mechanical structure and improve the strength of its carat-size diamonds, they will be able to compete with natural stones for drills, dressing tools, dies, and single-point cutting tools.

✓ ✓ ✓

Emphasizing the technological revolution that has jolted the entire aircraft industry, it has been revealed that more than half of Lockheed's 1960 business came from programs developed during the past five years, largely satellite vehicles, ballistic missiles and an economy sized jet transport.

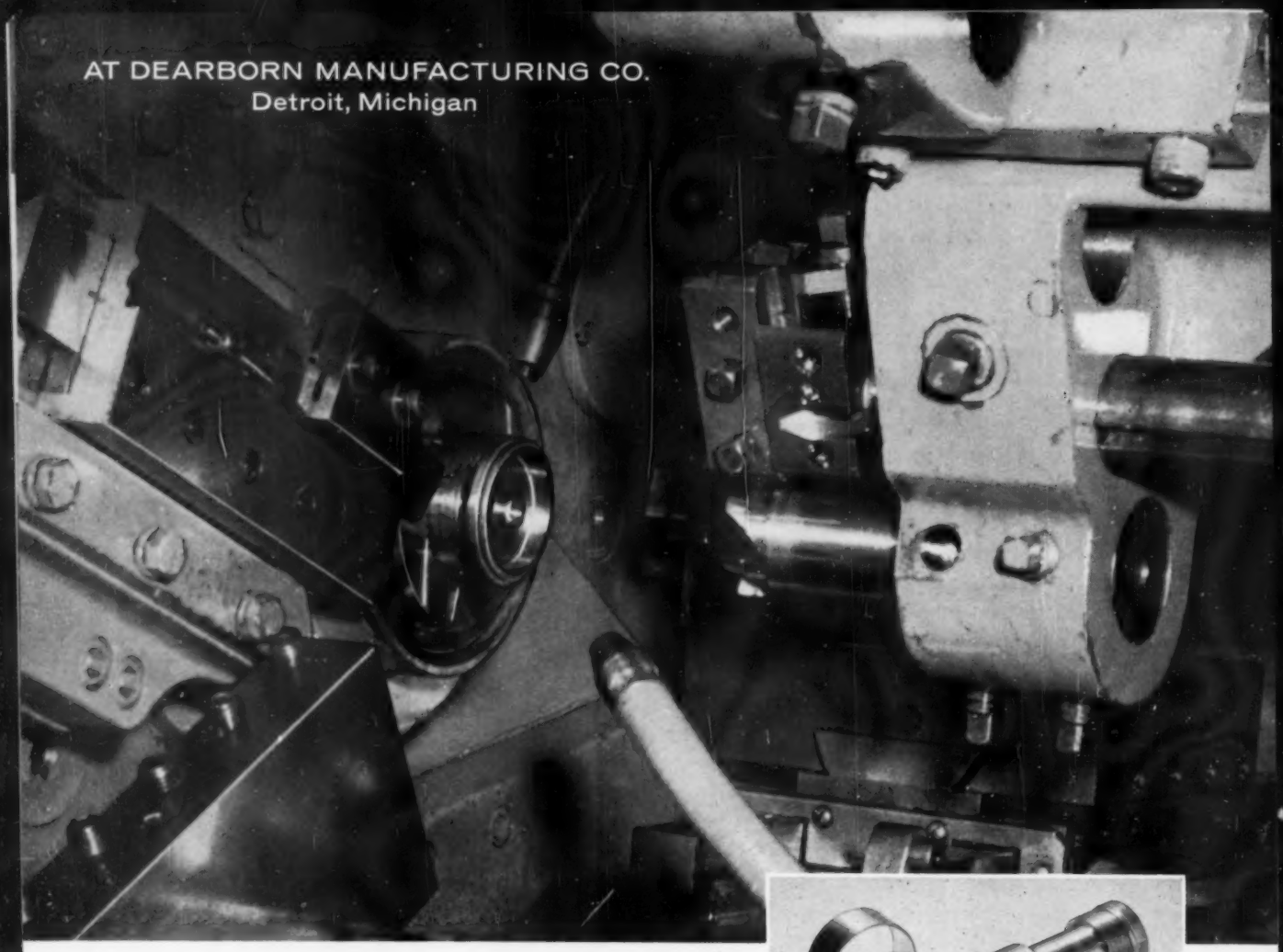
The proportion of research and development personnel needed to build modern aircraft and missiles has vastly increased since 1956. In five years, employment at Lockheed's scientific laboratories and engineering departments has more than doubled while the number of workers in manufacturing and related activities has dropped 24 percent.

✓ ✓ ✓

Speaking at the 65th Annual Congress of American Industry (sponsored by the National Association of Manufacturers), automation expert John Diebold recently called for the adoption of a positive program for fostering automation. His program involves: (1) making an intensive study of the human and economic factors of automation; (2) developing a tax policy aimed at encouraging technological innovations; (3) establishing a government agency to inform business of technological advances made in military research; (4) cooperative efforts by business, labor and government to encourage growth in problem areas; (5) reappraisal of the American educational system.

✓ ✓ ✓

Will the continuing advance of automation turn men into robots? Not so, says Dr. Simon Ramo, also speaking at the Congress of American Industry. Dr. Ramo believes the "Intellectronics"—the use of machines such as computers to do routine intellectual tasks—will free man so that he can concentrate on creative thought. In the future, Dr. Ramo believes, ". . . Intellectronics will give man the time, the intellectual stature, and hence the inclination to solve the world's social problems."



Precision blanking to .001 tolerances eliminates many secondary operations

Precision blanking of stainless steel parts on a 3-inch Warner & Swasey 2AB Single Spindle Bar Automatic is but one major advantage realized by Dearborn

Actually, three major factors led Dearborn Manufacturing Company to select the Warner & Swasey 2AB Single Spindle Bar Automatic:

1. The ability to hold tolerances to .001 on diameters; .002 on lengths; concentricities to .001 T.I.R., thus reducing secondary operations.
2. Tooling interchangeability with major customers also using Warner & Swasey 2AB's and 2AC's.
3. Quick and easy convertibility to chucking work.

In addition, the camless design permits Dearborn to make frequent setups and produce as few as 100 pieces at automatic rates. Tool interchangeability between the Warner & Swasey bar and chucking machines in Dearborn's own shop holds down standard tool inventory, and because of this unusual versatility of the 2AB, special tool costs are also minimized.

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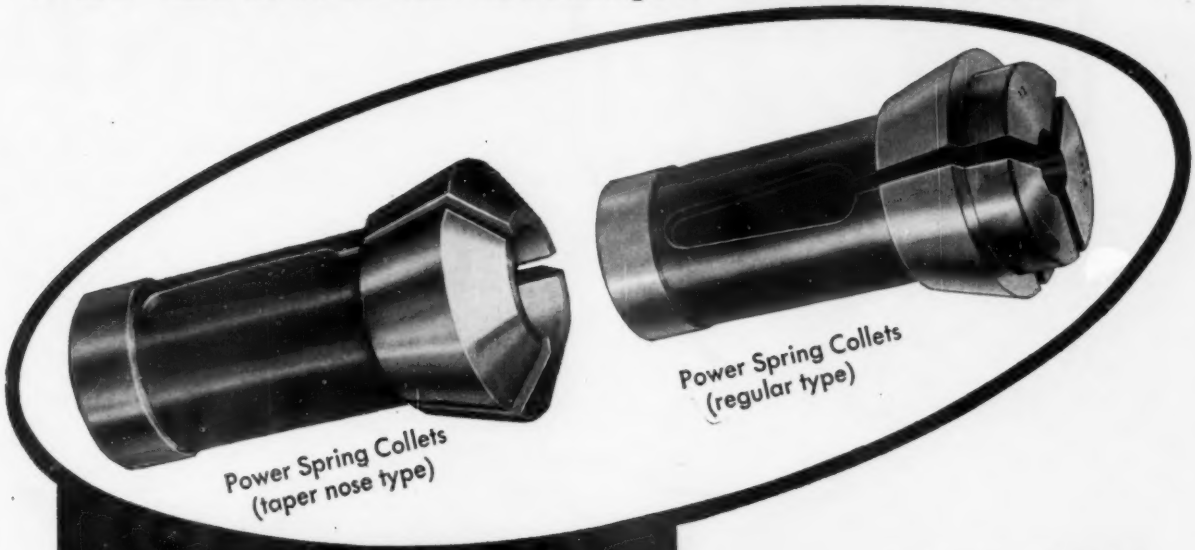
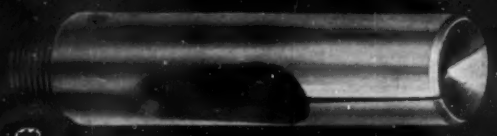
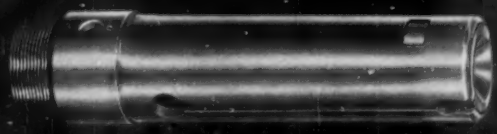




Feed Fingers (regular type)



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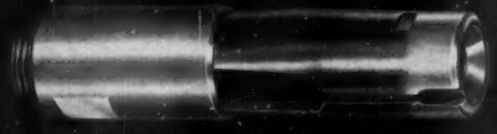

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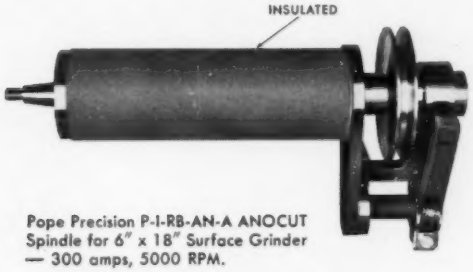
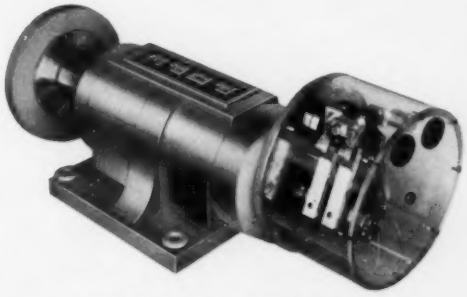
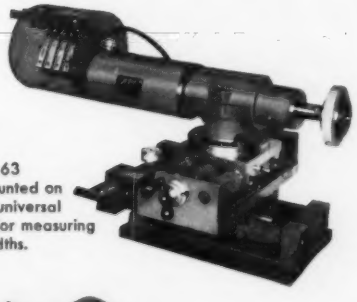


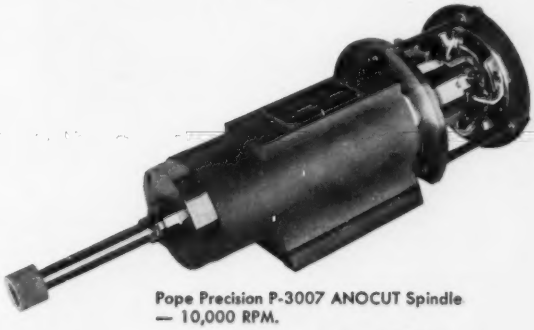
Pope Precision P-I-RB-AN-A ANOCUT Spindle for 6" x 18" Surface Grinder — 300 amps, 5000 RPM.



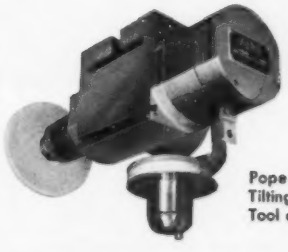
Pope Precision P-19162 ANOCUT Spindle; 1 to 20 HP, 1800 RPM.



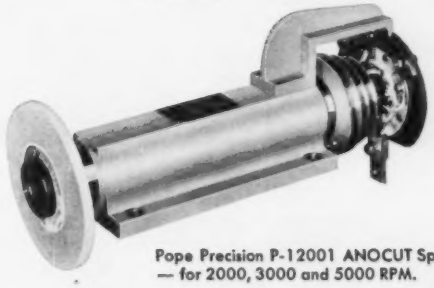
Pope Precision P-19163 ANOCUT Spindle mounted on Pope heavy duty universal slide with indicators for measuring feed in ten-thousandths.



Pope Precision P-3007 ANOCUT Spindle — 10,000 RPM.



Pope Precision P-6651-XG-S4 ANOCUT Tilting Head for attaching to Cincinnati #2 Tool and Cutter Grinder.



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Take A Close Look At Pipe Machinery's Small Thread Gages

. . . here's real craftsmanship! Extremely troublesome to many gage manufacturers, fine pitch threads in small diameters have long been a specialty at Pipe Machinery.

Hard to see in detail without a glass, such miniatures as those pictured above are made with the same painstaking attention to detail, the same dedication to quality and accuracy that go into all of our other gage products.

You'll find it pays to look to Pipe Machinery for small thread plug and ring gages that meet your strictest specifications for precision. For further information write us on your company letterhead today.

THE PIPE MACHINERY COMPANY 29100 Lakeland Boulevard • Wickliffe, Ohio • Greater Cleveland

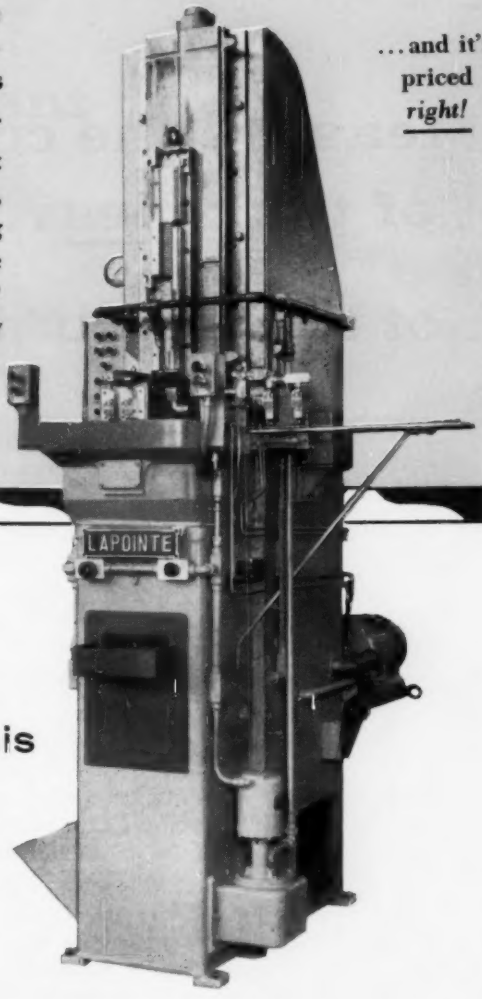
High production broaching of lightweight metals is the purpose of this extremely versatile machine, which is solving many problems where light tonnage and long strokes can be combined.

A noted American rifle manufacturer, for example, is Lapointe-Broaching the extractor pictured here, at the amazing production rate of 194 complete parts per hour — *with no further machining operations required on the broached surfaces.* Operation is fully automatic, including ejection of broached parts.

To lower your own production costs, while at the same time substantially improving your quality, you may find that this UVHS LAPOINTE Broaching Machine (or one of the others in our extensive series) can work miracles for you. Why not find out? An experienced Lapointe Field Engineer will gladly call on you, on request.

5-Ton, 54-inch Stroke

LAPOINTE Universal, Vertical, Hydraulic Single Ram BROACHING MACHINE can be adapted for **internal broaching** as well as **surface broaching.** Complete contour of the rifle extractor is broached in one pass, with stock removal approximately 50% of starting bar size. Steel bar stock .145" x .232" is automatically fed, clamped, broached and cut off to proper length of part. Production is 194 parts per hour, at 100% efficiency.



...and it's priced *right!*

Are you making
PRECISION GUN PARTS?
...MISSILE COMPONENTS?
If so, you should investigate this

uvhs LAPOINTE
fully automatic
BROACHING MACHINE

THE LAPOINTE MACHINE TOOL COMPANY
HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*
THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES

LAPOINTE
known to be the best in
BROACHING

Measure the cost of the holes . . .

not the cost of the tools

When you are faced with the problem of cutting the costs of your manufacturing operations, your best solution is to rely on *quality* tooling.

The small savings you may make on the initial purchase price of cutting tools can't possibly offset the extra dollars you lose in *higher cost per hole.*

You'll always save money with quality tools . . . the kind of tools that give you more holes per grind, more holes per tool, less down-time on your machines, faster production and fewer parts rejected.

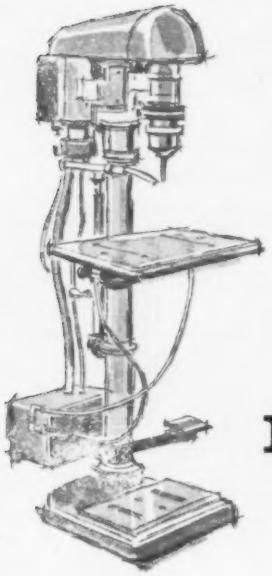
This adds up to *lower cost per hole.*

CLEVELAND Tools are designed and manufactured to highest quality standards. In every set-up, on any type of machine, they will help you reduce your costs. This has been proved time and time again in customers' plants.

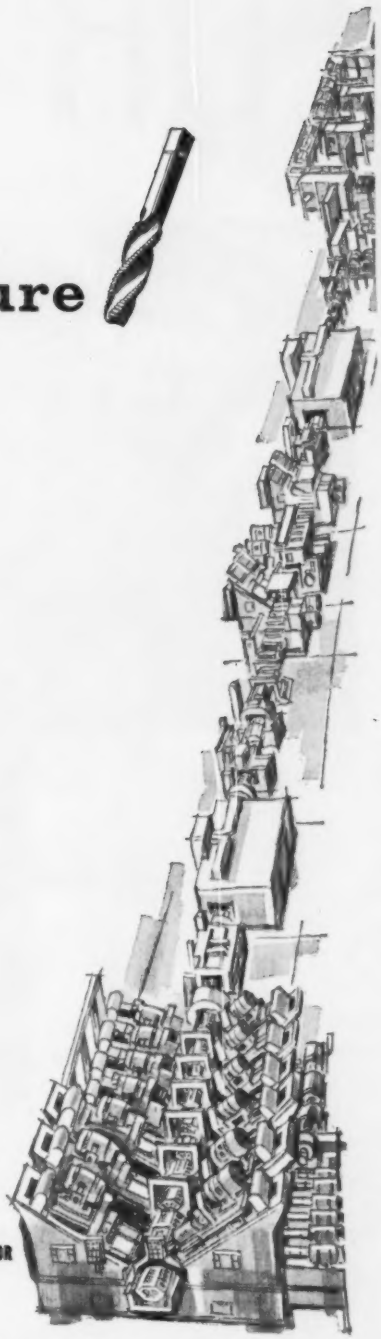
Moreover, CLEVELAND Quality Tools are sold exclusively through Industrial Supply Distributors, who carry complete stocks for prompt delivery. The steady flow of volume orders from hundreds of distributors enables us to produce the the full line of ◈ Quality Tools in large, economical quantities—with resultant advantages to you.

THE CLEVELAND TWIST DRILL CO.
Cleveland 1, Ohio

QUALITY CUTTING TOOLS • BEST SERVICE THROUGH YOUR LOCAL DISTRIBUTOR



How to prevent cutting tool failure



All of your equipment, from a $1,400 tapping machine to a $1,400,000 automobile engine block transfer machine, deserves *quality tooling*.

Tool failure, which often is the result of buying taps on the basis of price alone, causes excessive "down time", smaller output per hour, and higher cost per hole or per piece.

Quality taps, on the other hand, reduce tool failure to a minimum. They are your best assurance of efficient and continuous operation, high output, and lowest cost.

It just doesn't make sense to save a few pennies on the initial price of cutting tools. Lower priced taps are almost always the most expensive in the long run —and often for short runs, too!

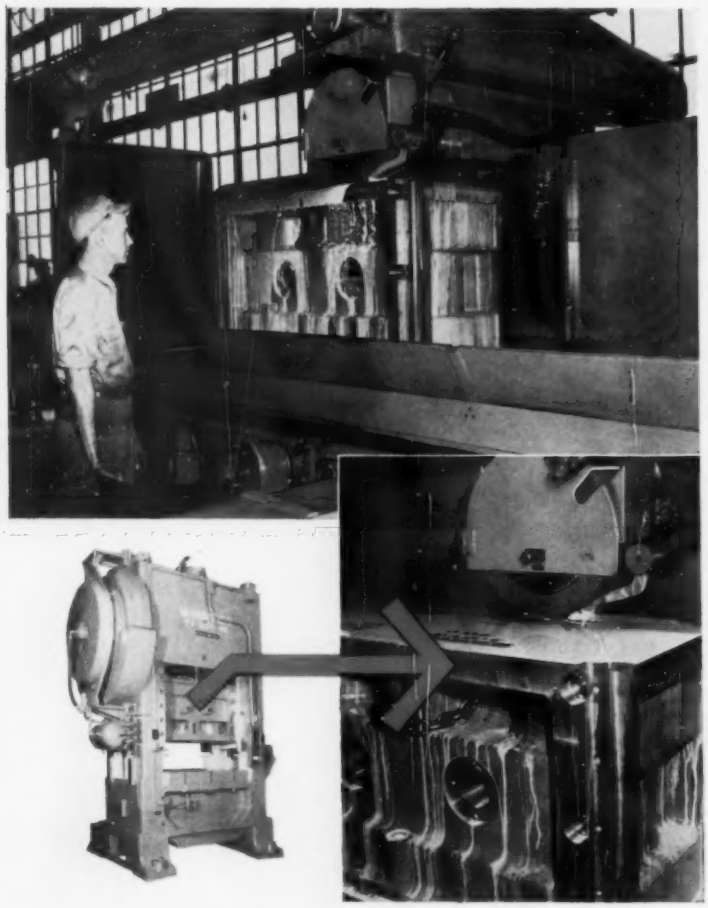
Telephone your Industrial Supply Distributor for BAY STATE Quality Taps. He can give you prompt delivery from stock.

BAY STATE TAP & DIE CO.
Mansfield, Mass.
Subsidiary of The Cleveland Twist Drill Co.

QUALITY CUTTING TOOLS • BEST SERVICE THROUGH YOUR LOCAL DISTRIBUTOR

SIZE FOR SIZE

there are no heavier or more accurate surface grinders made than these fast, heavy duty Thompsons



Thompson Type CX heavy-duty surface grinders are designed to grind heavy, massive work pieces. Their stock removal rate is very fast while maintaining extremely close limits of accuracy and microfinish.

Shown here is a Thompson Type CX 30x36x96 machine recently installed in the Minster Machine Company plant at Minster, Ohio. It is grinding the face of the slide for a 200-ton capacity Minster Piece-Maker High Speed Automatic Production press.

The slide is cast iron and weighs approximately 7000 pounds. It is being ground for precise parallelism and to a 20 to 30 RMS finish.

Thompson Grinders have an important part in the production of these world-famous Minster presses. The dependability of Thompson Service and the excellent performance of the Thompson machines now in use at Minster were major factors in the purchase of this latest grinder.

If your production involves the grinding of large, heavy work, it will pay you well to investigate the money and timesaving features of these modern machines.

THE THOMPSON GRINDER CO. Springfield, Ohio

Thompson SURFACE GRINDERS

"Keep Thompson in mind for that daily grind"

Use Reader Service Card, CIRCLE 14

Use Reader Service Card, CIRCLE 15

There's more to the buy than meets the eye

How do I know? We had a finish problem in reaming cast steel. Best finish we were getting was 150-175 micro-inch. We needed 60 or better. A W&B Service Engineer came in with one of their 1-1/16″ Chucking Reamers. He checked feeds and speeds—finally came up with .011 per revolution and 60 SFM. He recommended a secondary grind on the chamfer to assure clearance, then added a second chamfer of 67%. We were able to get and maintain a reamed finish of 40-50 micro-inches. At the end of the day, the operator was getting all good parts and saving substantial time per piece. In a case like ours, W&B's technical help, service and consistent reamer quality really convinced me that initial price is merely one factor. Find out for yourself . . . test W&B tools in *your* plant under *your* conditions. Call them in direct or through your industrial distributor. Do it today. See if *you* can't get better results.

W&B

PARTNERS IN PRODUCTION PROGRESS

WHITMAN & BARNES

40000 PLYMOUTH ROAD • PLYMOUTH, MICHIGAN

DRILLS • REAMERS • END MILLS • COUNTERBORES • COUNTERSINKS • CARBIDE TOOLS • SPECIAL TOOLS

Anaconda takes to the road with ideas for greater values and higher productivity

We're in the market with ideas. Ideas for doing new jobs—like making transistor bases and fluid-cooled conductors. Ideas for doing present jobs better—helping you match the metal to the job more precisely so that you can offer equal or greater value *and* reduce total costs.

These ideas are embodied in Anaconda's line of copper, brass, and bronze mill products, the broadest in the industry—and in the vast pool of experience and technical knowledge of Anaconda men.

To put these ideas to work we've taken to the road with a traveling value-analysis clinic, stopping in industrial centers all over the country. We've a truckload of displays representing our principal products to serve as starting points for discussions of the ideas. We're detaching specialists, technical men, mill men, executives to discuss and explain the ideas with all manufacturers who can attend the clinics.

We're also busy generating new ideas in an aggressive research and development program. And we plan to make available soon small, balanced value-analysis teams to go out in the field and work with individual company organizations—make specific suggestions and recommendations regarding materials, fabricating methods, design, etc.

Anaconda is on the move. If you have problems in which you think a new approach might help—call your Anaconda American Brass representative. Or write: Anaconda American Brass Company, Waterbury 20, Conn.

60106

ANACONDA®

COPPER—BRASS—BRONZE
NICKEL SILVER MILL PRODUCTS

Anaconda American Brass Company

Now—A Low-Cost Way to Build Jigs & Fixtures!

PRE-MACHINED MICRON SECTIONS PUT YOUR TOOLROOM JOBS ON A PRODUCTION BASIS

Next time you need fixtures for short-run milling or drilling jobs, use Ex-Cell-O Micron Sections to produce them quickly and at low, low cost!

High tensile strength cast-iron Micron Sections give you inbuilt accuracy plus substantial savings in design and building time; you eliminate welding, cut machining time.

Simply select the desired shape and size from Ex-Cell-O Bulletin B-5914, and specify the length required; we'll deliver the sections you need—pre-machined and ready for minor detailing.

Micron Sections are available from stock by ordering through your local Representative or direct from Ex-Cell-O. Send for data sheet and price list today.

BRIEF SPECIFICATIONS

Cut to order from 25″ lengths. Wall thicknesses from ⅛″ to 1¼″. Width and height from 3″ x 3″ to 8″ x 8″. Machined square and parallel within .005″ per foot on all surfaces except ends and interiors of hollow shapes.

EX-CELL-O FOR PRECISION

Machinery Division

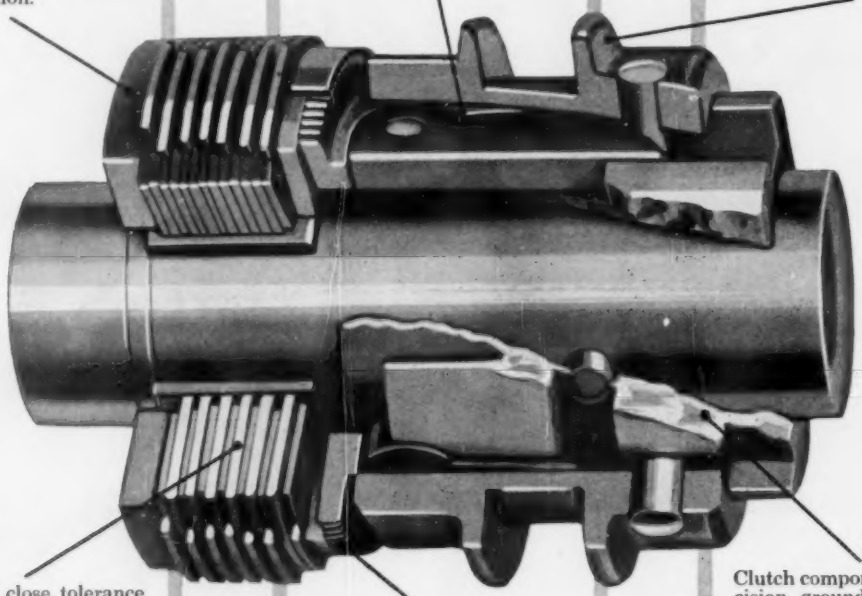
EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • ATOMIC ENERGY EQUIPMENT • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN 60-7

Symmetrical design and precision machining assure smooth clutch operation. Torque is not affected by centrifugal force or direction of rotation.

Low axial pressure to levers gives positive, instantaneous engagement. High-ratio levers are case hardened forged steel. Immediate disengagement.

Use any actuation device — air, manual or electric. Slight pressure to shifting spool engages clutch. Spool length prevents binding and gives longer life.



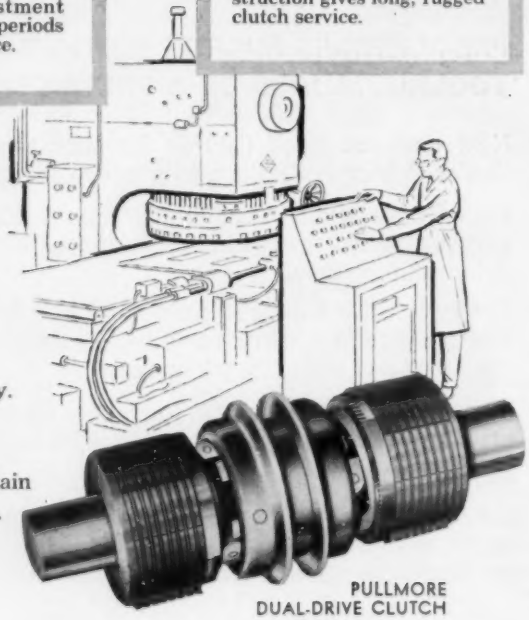
Discs meet close tolerance flatness checks. Heat treated steel, graphite-impregnated bronze, sintered bronze or molded discs for oil and dry operation.

Easy Adjustment... simply raise locking spring and turn collar. Adjustment lasts for extra-long periods of heavy-duty service.

Clutch components are precision ground and highly concentric. Locking split ring assures positive axial positioning. Strong construction gives long, rugged clutch service.

Increase production with Pullmore Clutches

Modern, high-production machines depend on efficient clutch controls. Today's clutches must be versatile, must provide fast but smooth actuation, must transmit full power and must be designed for enduring controllability. Rockford Pullmore Clutches meet these requirements. They start, stop, reverse, shift, inch, cycle and idle. Pullmore dual-drive clutches drive forward and reverse, obtain high and low speeds, or control as clutch-brake combinations. Engagement is fast, smooth and positive. The high torque, compact clutches handle loads from 126 to 11,000 inch lbs. Write for illustrated brochure.



PULLMORE DUAL-DRIVE CLUTCH

ROCKFORD CLUTCH

1329 EIGHTEENTH AVE., ROCKFORD, ILLINOIS

Export Sales Borg-Warner International • 36 So. Wabash, Chicago, Ill.

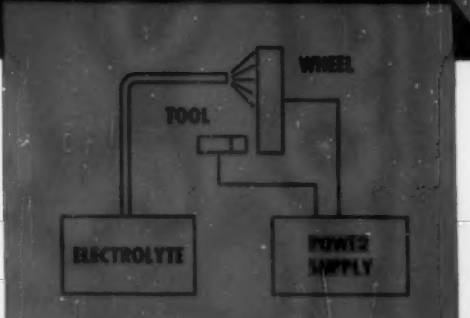
ROCKFORD BW CLUTCH DIVISION OF BORG-WARNER

NEW

Reciprocating Electrolytic Tool Grinder

MICRO-FINISHES CARBIDES, CUTS DIAMOND-WHEEL WEAR 80%

59-25



ELECTROCHEMICAL METAL REMOVING "LETS THE ELECTROLYTE DO THE GRINDING"

As conductive, metal-bonded wheel reciprocates across face of tool, inexpensive salt-solution flows between the tool and the wheel, creating electrolytic cell; the tool becomes the anode. Material is removed essentially as in a deplating process—but at much higher speed—leaving burr-free finish.

Use Reader Service Card, CIRCLE 19

Because its reciprocating wheel just "wipes away" the carbide particles, Ex-Cell-O's Style 264 Electrolytic Tool Grinder reduces diamond wheel consumption by as much as 80 per cent! With one set-up, tools can be precision-finished to better than 15 micro-inches—free from heat checks, cracks or burns caused by abrasive contact.

The Style 264 grinds the cutting edges of carbides and other super-hard tool materials at one end, grinds chip breakers at the other. Wheel stroke is fully adjustable. Standard equipment includes: Ex-Cell-O Precision Spindle with inbuilt reversible motor, universal chip breaker fixture (shown in circled inset, above), and pressure system for electrolyte.

Write direct, or see your Ex-Cell-O Representative for details on the Style 264, conventional Style 142 Reciprocating Tool Grinder, and others in the complete Ex-Cell-O line.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

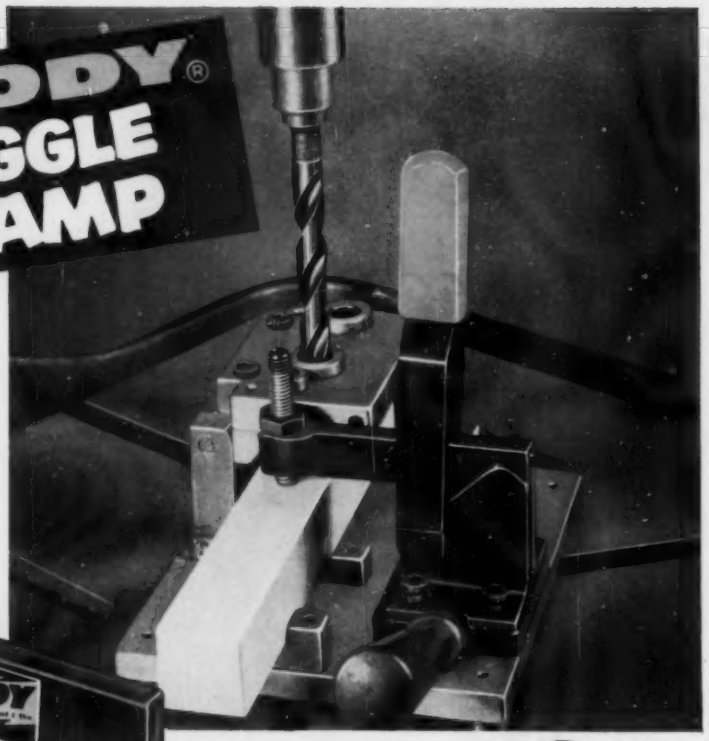
XLO
EX-CELL-O FOR PRECISION

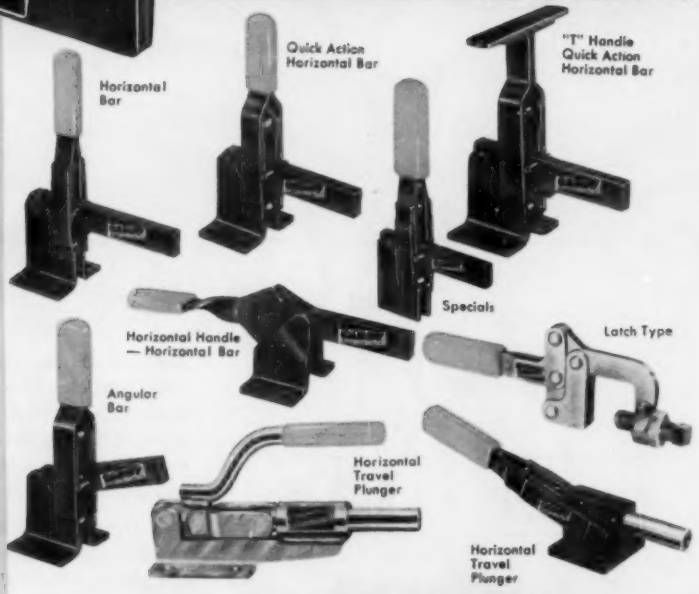
Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

CADDY® TOGGLE CLAMP

TYPE V





CADDY Type V Toggle Clamps feature all welded construction. Four sizes are available with clamping pressures from 800 lbs. to 2,000 lbs. Built to outlast any clamp on the market. Clamps have black finish with yellow plastic handles. Bolt retainer is furnished with each clamp.

1. **EXTRA LARGE PIVOT PINS—Up to 3 times more bearing surface than other clamps. In actual test under load, V-3 clamp withstood 250,000 cycles without excessive wear.**
2. **ALL WELDED CONSTRUCTION—Will not come apart even after pins become excessively worn.**
3. **HEAVIER FRAME—Will not spring or bend under maximum load.**
4. **HEAVIER LINKS AND HANDLE—Will withstand extreme abuse. Pipe extension handle may be used without damage to linkage.**
5. **REINFORCED CLAMP BAR—Eliminates weak point where pivot pins pass through bar.**
6. **DOUBLE CLAMPING PRESSURE—Design of linkage provides double the clamping pressure of competitive clamps at the same pressure on the handle.**

CADDY®

Toggle Clamp Div. ERICO PRODUCTS, INC.
2070 E. 61st Place Cleveland 3, Ohio

☐ PLEASE SEND CATALOG
☐ PLEASE HAVE REPRESENTATIVE CALL

NAME_____ TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ STATE_____

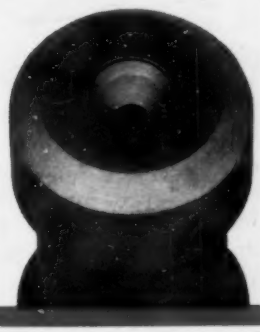
DO YOUR OPERATIONS DEMAND ACCURATE CENTERS?

Ex-Cell-O Center Lapping Machines Increase Accuracy, Reduce Scrap!

Precision Center Lapping Machines remove heat-treat scale, and eliminate roughness and distortion of centers to insure accuracy in subsequent operations.

Easy to use and modestly priced, Center Lapping Machines include as standard, inbuilt equipment Ex-Cell-O Precision Spindle and manual diamond dresser.

See your Ex-Cell-O Representative, or write for Bulletin 40271.

BEFORE LAPPING		AFTER LAPPING
• Out of line • Out of round • Incorrect angle • Rough or torn		• Perfect alignment • True roundness • Precise angle • Mirror-smooth

60-37

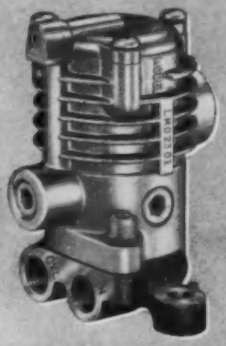
EX-CELL-O FOR PRECISION

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • ATOMIC ENERGY EQUIPMENT • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

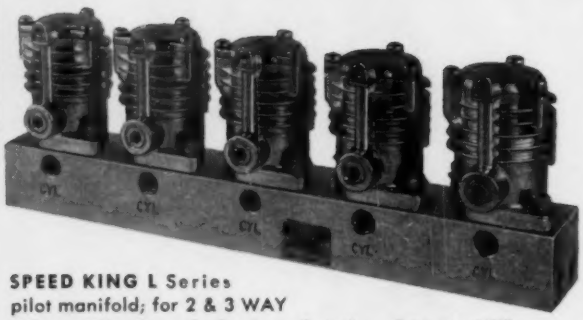
Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Use Reader Service Card, CIRCLE 21



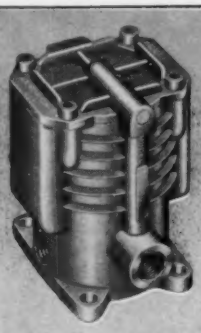
SPEED KING L Series pilot; 2 & 3-way NO & NC; foot, subbase or manifold mounting; 1/16 to 1/8 in. orifices. Subbase mounting shown.



SPEED KING L Series pilot manifold; for 2 & 3 WAY NO or NC pilots; 2, 3, 4 or 5-station, 1/4 in. NPT cylinder ports. 5-station shown.

for dependable, economical control, specify versatile...

SPEED KING®
SOLENOID PILOTS



SPEED KING P Series pilot; 2 & 3-way NO & NC, 4-way; foot, subbase or manifold mounting; 1/8 or 3/16 in. orifices. Foot mounting shown.

Compact Valvair® SPEED KING pilots are ideal for control of small air or vacuum-operated devices including cylinders up to 3 in. bore, as well as for piloting larger valves. Featuring Valvair's flow-thru cooling design, they offer multi-million cycle dependability, with solenoid coils guaranteed against burnout for the life of the valve. Choose from a full range of types, mounting styles and sizes; integral junction boxes (L Series only) and manual override optional; coils for ac or dc, any voltage.

Solve your small unit control problems with SPEED KING solenoid pilots. Your Bellows-Valvair Field Engineer can recommend a size and type exactly suited to your requirements.

Write for free Bulletin PIL. Address: Bellows-Valvair, Akron 9, Ohio. Dept. TE-261.

8162

NFPA NATIONAL FLUID POWER ASSOCIATION

Bellows-Valvair

AKRON 9, OHIO

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

New NUMERA-TROL (XLO) Automatically Selects Bore Size and Location!

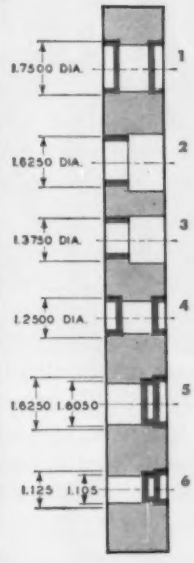
Only Ex-Cell-O's Model 758 Numera-Trol Machine combines a breakthrough in tape-control application with a unique concept in machine design to give you these exclusive production capabilities:

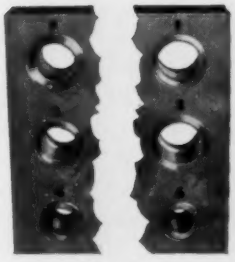
- Automatic pre-selected bore diameter control during machine cycle
- Automatic work positioning for infinite center locations
- Automatic straight-boring, step-boring and counterboring from either end of machine

Using interchangeable boring bars which respond to tape control through a new mechanism developed by Ex-Cell-O, the Model 758 Numera-Trol lets you program variable bore diameters. (Tools are available giving an infinite range of diameters in one-inch increments.) Bore diameters are controllable within .0005", bore depth is controllable to plus or minus .0005".

Infinite bore locations, accurate within .0002" of true center, are possible within the Model 758's 10-inch cross slide and vertical slide strokes.

Infinite, too, are the Model 758's applications. Your Ex-Cell-O Representative can give you complete details, or write direct for Bulletin 506015.





On this workpiece, tape-controlled sequence is programmed from largest to smallest diameters; automatic boring bar adjustment is made at the end of each stroke to eliminate drawback lines. Model 758 holds concentricity within very close tolerances.

60-84

EX-CELL-O FOR PRECISION

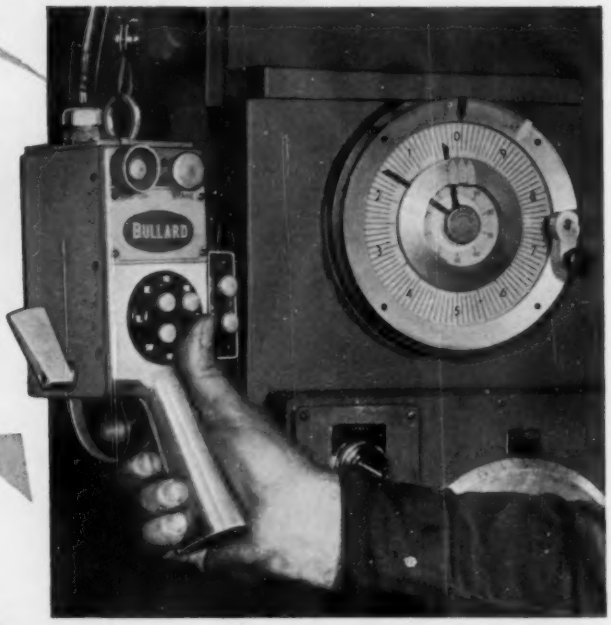
PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS • PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Lower Costs — Increase Profits with

CENTRALIZED POWER CONTROL



..... on the BULLARD DYNAMILL* H.B.M.

Large, easy to read clock-type dials allow the operator to "power" position the head, table, saddle and spindle in relation to the work piece without the use of hand cranks or levers. These dials, when the machine is equipped with numerical control, provide an accurate, instantaneous visual read-out on the positioning of the system.

Simple push buttons on the control pendant direct all motions of the head, table, saddle and spindle. Spindle start and stop, as well as spindle speed changes, are controlled from buttons on the pendant. Four traverse rates and feed engagement are actuated by the operator's forefinger on the pendant trigger.

Thus, within the span of a man's hand, are centralized power controls which allow the operator to keep the tool in the cut more of the time — thereby reducing costs and increasing profits.

For Complete Information,
ask your nearest Bullard Sales Office for a catalog or write to

*Trade Mark

THE BULLARD COMPANY • BRIDGEPORT 9, CONNECTICUT

Use Reader Service Card, CIRCLE 24

Use Reader Service Card, CIRCLE 25

high lubricity in water

Stuart's SOLVOL liquid cutting compound

Stuart

You may not be using soluble oils for "big chip" machining. But there is a super-lubricity compound—Stuart's Solvol—designed specifically for these jobs. A cutting fluid more and more of America's top companies are using for broaching, milling, and heavy-duty turret lathe work.

Compounded of a high-lubricity fatty oil, petroleum base, and a heavy-duty emulsifier, Solvol gives you the right combination of lubricity and cooling action for economical tool life at efficient machine speeds. Here's why . . .

Extremely fine particles of fatty oil are suspended in water like millions of delicate organisms under the sea. Fatty oil that comes from the sea—the best fat for lubricity money can buy. Solvol's high concentration of sperm oil allows chips to slide over the tool face without high friction and heat build-up. Stops chip welding and tool breakdown.

You get all these advantages in a water-mix compound that cools faster, eliminates smoke, handles a wide range of cutting operations at the lowest possible tool lubrication cost.

So, when you make the switch from straight oils to a water-mix cutting fluid, don't sacrifice lubricity. Because Solvol combines both—the cooling capacity of water, with the extra lubricity you need for economical machining.

low friction · high finish

Stuart's CODOL liquid grinding compound

Grinding experts will tell you there's only one way to get a slick surface finish without going to extremely fine grit wheels or a straight grinding oil—and you don't have to give up wheel life or cooling action to get it.

That is by utilizing the balanced lubricating and scrubbing action of a water-mix like Stuart's Codol liquid grinding compound. For Codol's balanced formula provides the high surface finish advantages of a straight oil . . . in colloidal form . . . plus the cooling capacity of water.

Extremely fine oil particle size results in a near-transparent solution. Codol is not an opaque emulsion like most soluble oils . . . yet, it has none of the machine maintenance disadvantages of transparent compounds.

Use Codol when you want to keep grinding wheel inventory costs at a minimum and production efficiency right at peak.

Stuart

D. A. STUART OIL CO., LIMITED
2727 South Troy Street, Chicago 23, Illinois

Canadian D. A. Stuart Oil Co., Limited, P. O. Box 430,
43 Upton Road, Scarborough, Ontario, Canada

ANOTHER NORTON PRODUCT

New "KONTOOR" Bands

6 ways better for pneumatic drum grinding

Fact is: KONTOOR beats all other bands because of unique Behr-Manning construction. With cloth cut on the bias, these bands readily conform to crowned pneumatic drums. Use a crowned drum and a KONTOOR Band and benefit by:

1. No edge-cutting problem, as with flat bands.
2. Easy working of extremely narrow areas; the entire surface of the band is eventually used.
3. Self-shaping KONTOOR Bands conform to the curved shape of the crowned wheel in seconds.
4. Can be run under lower air pressure; reduces chatter marks while blending and finishing.
5. Crowned band is ideal for working on curves; especially on internal surfaces.
6. KONTOOR Bands have the non-loading and non-shedding advantages of RESINALL bond.

Ask for a demonstration. Call your nearest representative or write Dept. TE-2, BEHR-MANNING Co., Troy, N. Y., a division of Norton Company.

BEAR Abrasives

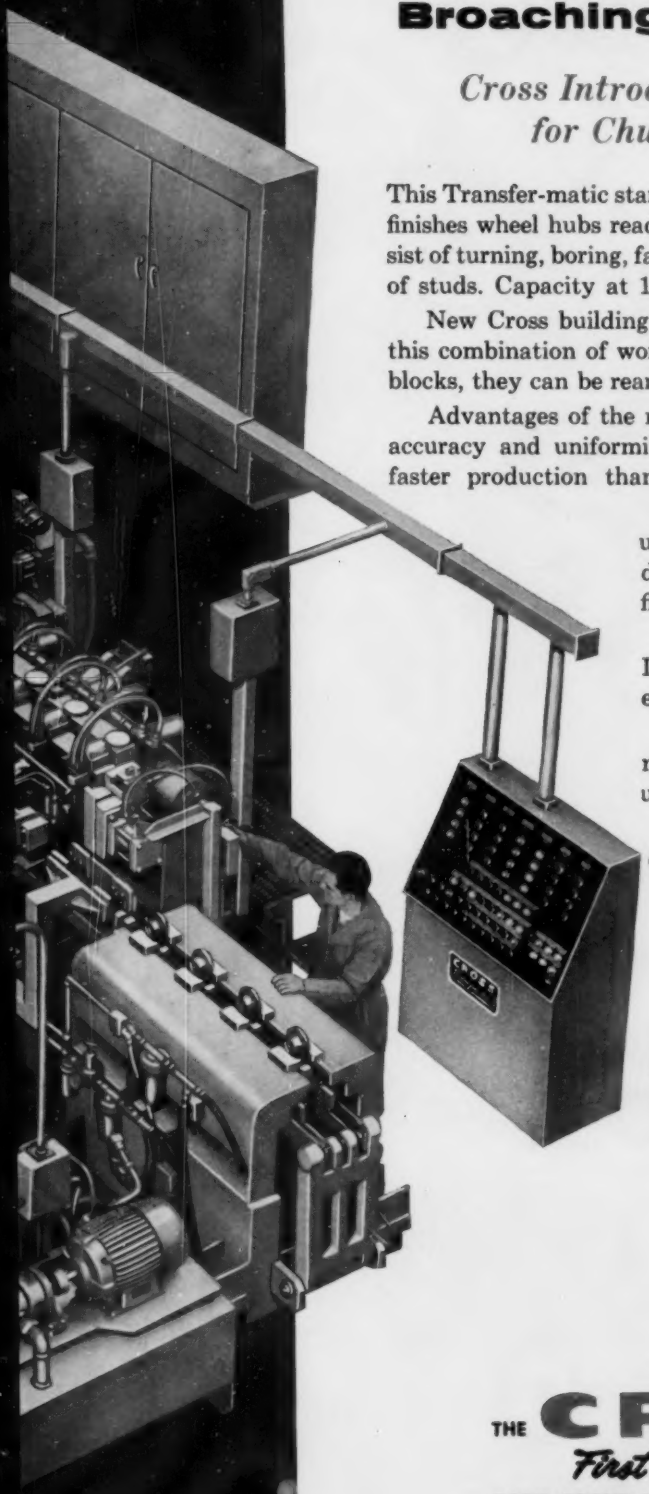
Use Reader Service Card, CIRCLE 27

Tool slides are rotated to the upward position so tools can be seen, reached and replaced easily.

Another Automation First by Cross

New Transfer-matic Combines Chucking with Drilling, Broaching and Assembly

Cross Introduces Building Blocks for Chucking Operations



This Transfer-matic starts with rough castings and completely finishes wheel hubs ready for final assembly. Operations consist of turning, boring, facing, drilling, broaching, and assembly of studs. Capacity at 100% efficiency is 200 parts per hour.

New Cross building blocks for chucking operations make this combination of work possible. Like other Cross building blocks, they can be rearranged as requirements change.

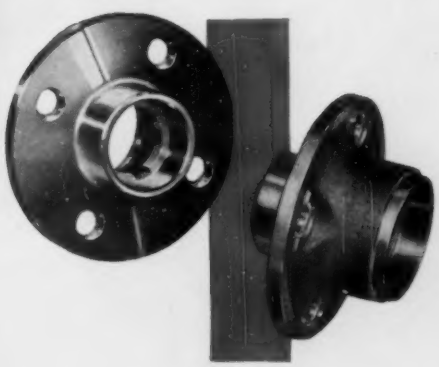
Advantages of the new Transfer-matic include maximum accuracy and uniformity, higher output, less handling, and faster production than conventional methods.

Heavy duty, three jaw chucks are used on the roughing operations but diaphragm types are employed for finishing to avoid clamping distortion.

A work bank between Sections I and II permits independent operation of either one during maintenance.

The new building blocks include a novel slide unit which tilts the tools upward to speed changes.

Cross engineers will gladly discuss details of this Transfer-matic with you.



Established 1898

THE **CROSS** CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

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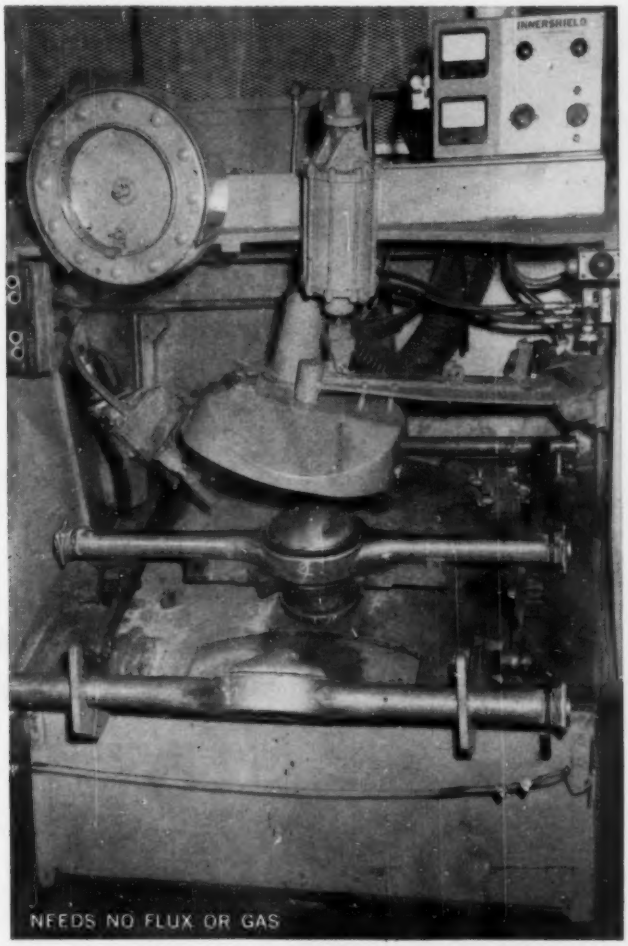
It's what's inside that counts

NEW TUBULAR ELECTRODE

Now quality automatic welds can be made without CO_2, Argon or granular flux. Photo magnifies electrode 3½ times.

NEEDS NO FLUX OR GAS

LINCOLN'S dramatic new welding process—INNERSHIELD —uses a special tubular electrode containing all necessary ingredients—filler metal, arc shielding, deoxidizers, fluxes. Two new welders use it—a full automatic and a semi-automatic.



This is Lincoln's Innershield at work . . . full-automatic. No other automatic process even comes close to the speed. You press the button to weld and really lay down a bead fast . . . over 300 inches per minute on light gage lap or butt welds. The dust cap and flanges of this axle housing demonstrate how Innershield really goes to work—they are welded 60% faster with Innershield than with the previous process.

This is Lincoln's Innershield Squirt . . . on the job. It's ideal for high-speed, single-pass welding on light metal parts like these building trusses. Deposition efficiency is high, since the electrode is a continuous 50-pound coil. In this operation, Innershield increased welding speed 30%. That's not all: because this automatic electrode contains *ALL* the welding ingredients, purchasing, inventory and storage are simplified.

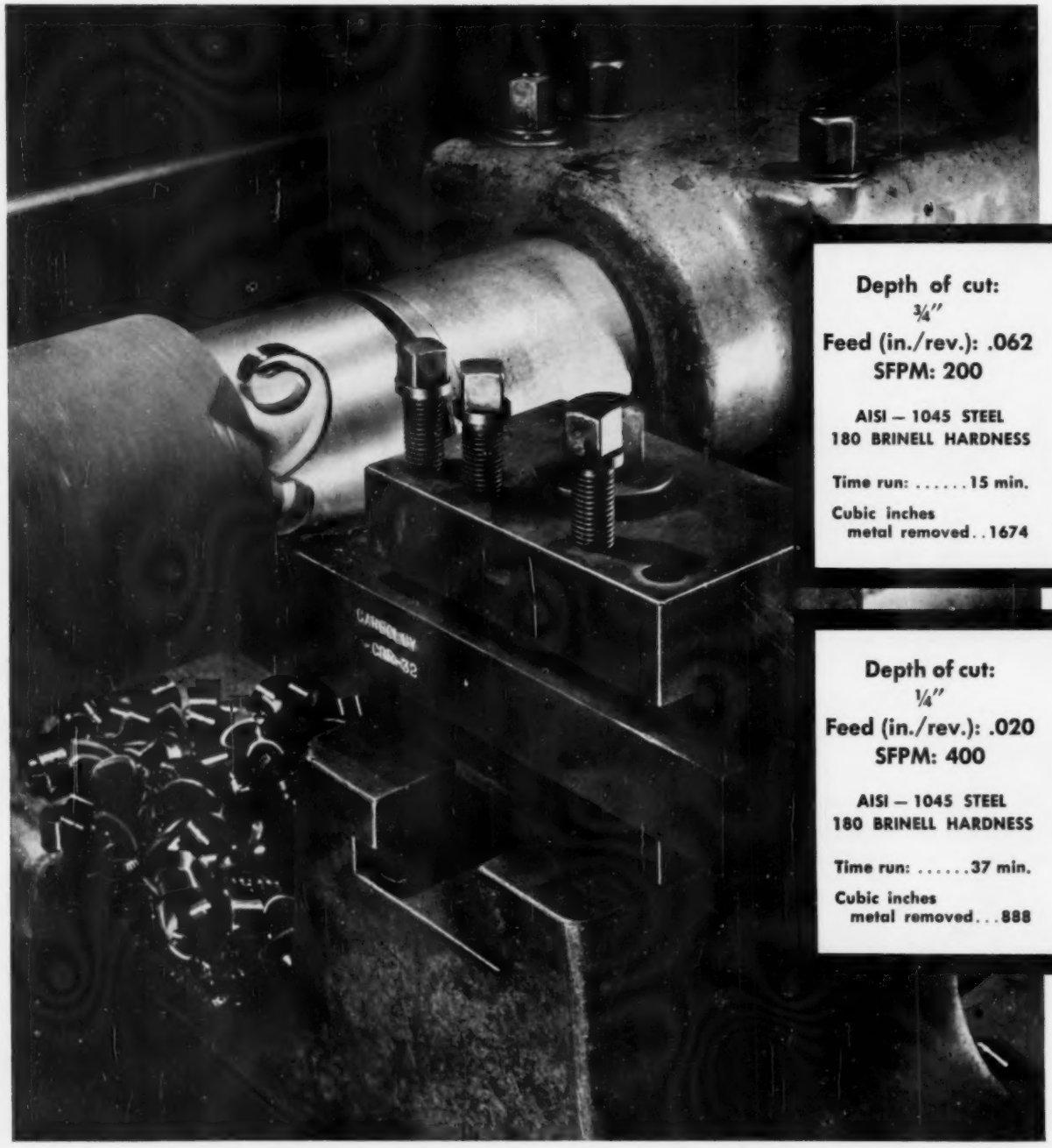
Here's the inside story . . . how the cost-cutting, profit-producing advantages of Innershield can go to work for you. A new bulletin, hot off the press, covers the dramatic story of the new tubular electrode and how it works. It also describes in detail both the full and semi-automatic Innershield welders now available. Write for your copy of bulletin 5300.1 today. The Lincoln Electric Company, Dept. 3011, Cleveland 17, Ohio.

LINCOLN WELDERS

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT AND ELECTRODES

Use Reader Service Card, CIRCLE 31

Why ?



Depth of cut:
¾"
Feed (in./rev.): .062
SFPM: 200

AISI – 1045 STEEL
180 BRINELL HARDNESS

Time run: .....15 min.

Cubic inches metal removed..1674

Depth of cut:
¼"
Feed (in./rev.): .020
SFPM: 400

AISI – 1045 STEEL
180 BRINELL HARDNESS

Time run: .....37 min.

Cubic inches metal removed...888

Why is one Carboloy® carbide grade best for light-duty steel-cutting applications; another more suitable for heavy-duty jobs? And which should you use?

Carbide selection can be scientific (and *should* be!) if you are going to get optimum results from your steel-cutting operation.

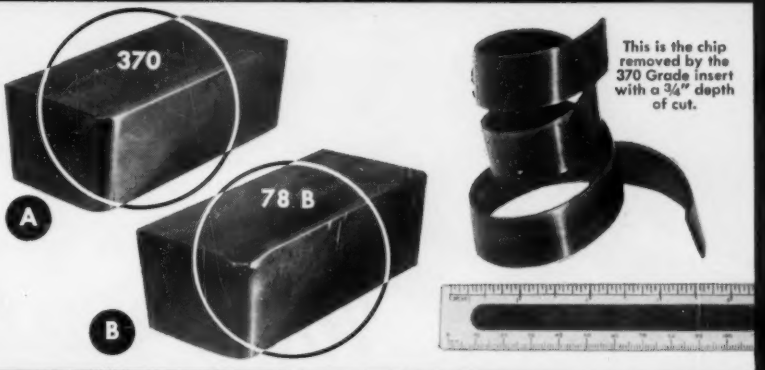
Take the job-graded Carboloy Grades 78B* and 370, for example. The 78B Grade is designed to offer real economy in normal steel-cutting applications—where machine power is limited. The 370 Grade, on the other hand, was developed specifically for heavy-duty steel-cutting jobs. Look over the following examples; then contact your Carboloy representative, or Authorized Carboloy Distributor, for information on Carboloy *job-graded* carbides for your specific operation. Take advantage of *better profits through better tooling.* Call today, or write: *Metallurgical Products Department of General Electric Company, 11101 E. 8 Mile Street, Detroit 32, Michigan.*

*Carbides in 78 Series are all pre-honed. Carbides in the 300 series are available pre-honed, precision-ground, or utility-ground.

HEAVY-DUTY MACHINING

Photograph A shows the Carboloy 370 Grade insert after the run. Wear land was only .012", and there is no deformation (upsetting) of the cutting edge. Photo B shows the 78B Grade insert after the same run. Note the deformation of the cutting edge . . . Grade 78B was not designed for such severe cutting pressures.

CONCLUSION: *In this heavy-duty application, Carboloy 370 Grade is recommended.*



LIGHT-DUTY MACHINING

In this light-roughing application there is little visible difference between the Carboloy 78B Grade insert (Photo A) and the 370 Grade insert (Photo B). Because 78B Grade is job-graded for light- and medium-roughing applications, it will wear as long as 370 Grade. Grade 78B insert is lower in initial cost, so in this case it makes good sense to use Grade 78B. In this example, the wear land on 78B insert was only .010".

CONCLUSION: *In this normal steel-cutting application, Carboloy 78B Grade is recommended.*

CARBOLOY® CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

MORE CUTS PER WHEEL MEAN *"MORE USE PER DOLLAR"*

With Faster, Cleaner MANHATTAN CUT-OFF WHEELS

Every Manhattan Cut-Off Wheel is custom-bonded for the specific cut-off job—whether you work with hardened or soft steels, light gauge tubing, or critical alloys. And custom bonding means safe, fast, clean, cool cutting over sustained periods . . . saves you both time and money. Recent Manhattan developments in both rubber and resinoid bonds assure this greater cutting efficiency . . . and longer life for the wheels.

Manhattan Cut-Off Wheels are manufactured to meet your requirements in the widest range of types and sizes. Manhattan Abrasive Wheel engineers will assist you in selecting the exact construction to improve cut-off operations at your plant. They'll show you how you can save time and money . . . get "More Use per Dollar" . . . with Manhattan Cut-Off Wheels and other types of high speed, heavy duty wheels.

RM-1059

WRITE TO ABRASIVE WHEEL DEPARTMENT

MANHATTAN RUBBER DIVISION • PASSAIC, NEW JERSEY

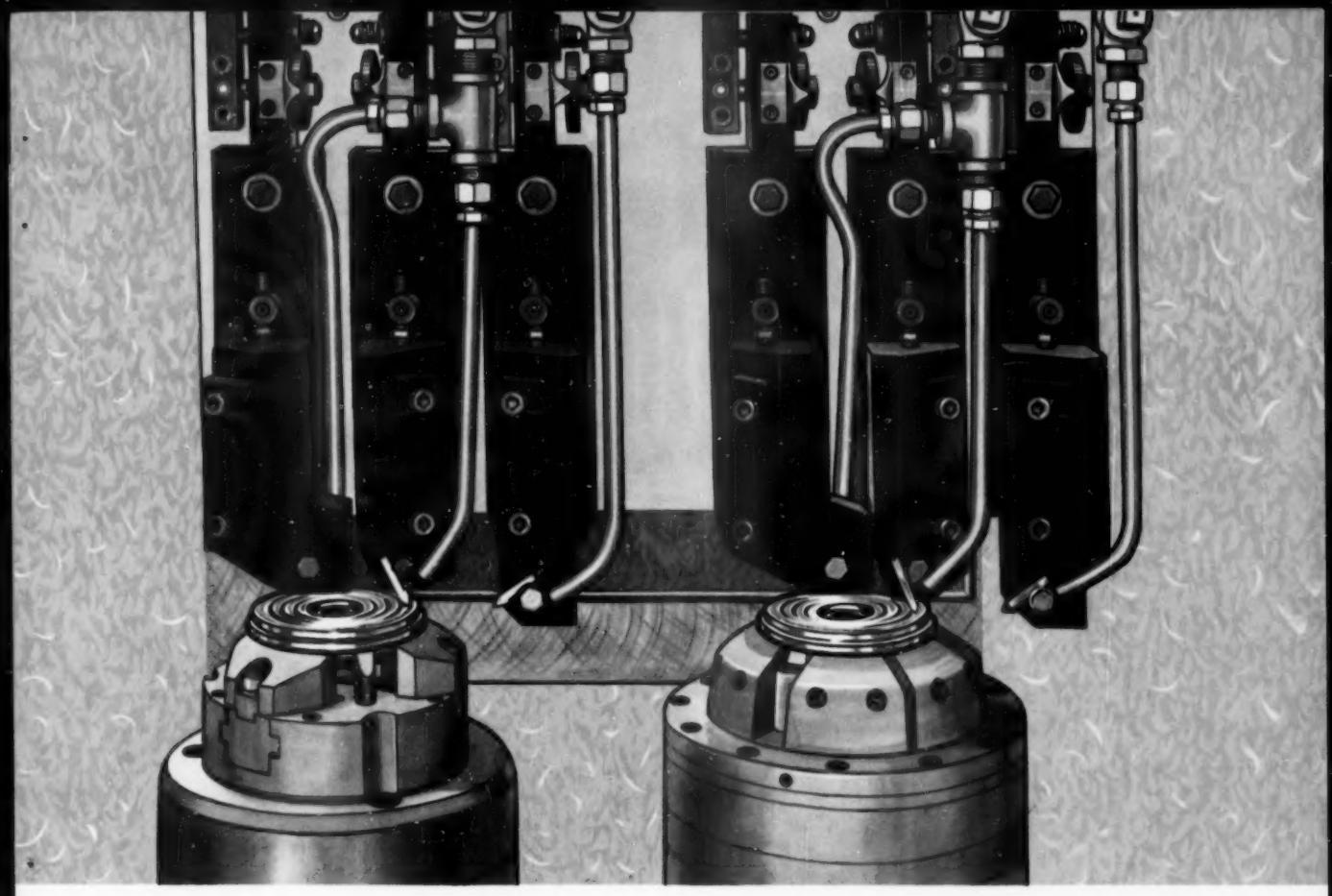
RAYBESTOS-MANHATTAN, INC.

RM

ENGINEERED RUBBER PRODUCTS ... MORE USE PER DOLLAR

Use Reader Service Card, CIRCLE 34

Use Reader Service Card, CIRCLE 35



New Britain's new concept for contour turning and boring

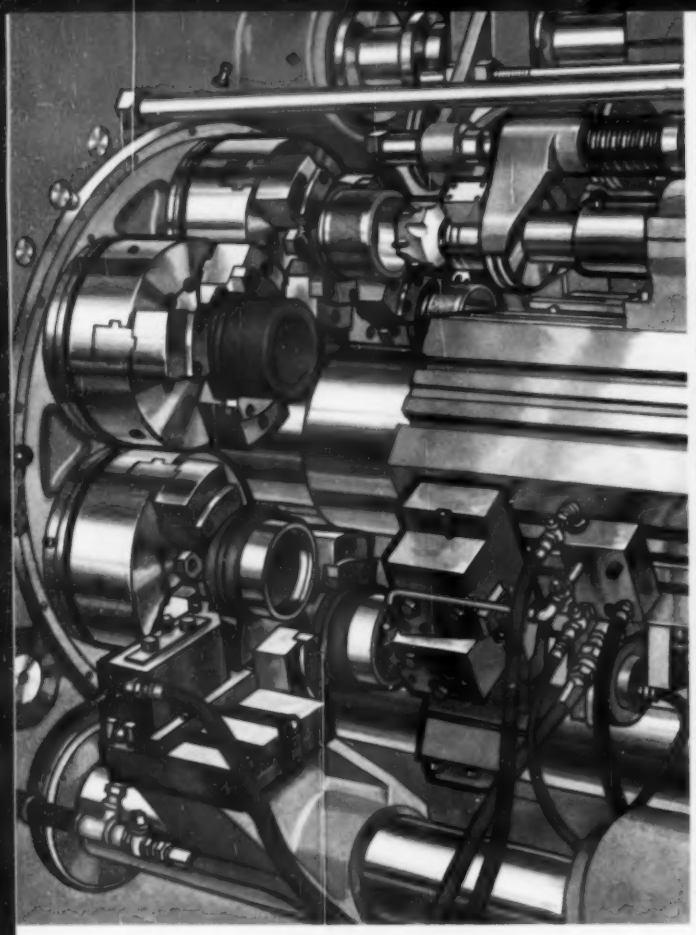
Beyond a certain point, continued refinement of existing designs in machine tools ceases to make an appreciable contribution to performance. Thus in designing our New Series of Vertical Precision Boring Machines, we have incorporated several completely new design concepts to provide improved performance and greatly increase over-all usefulness.

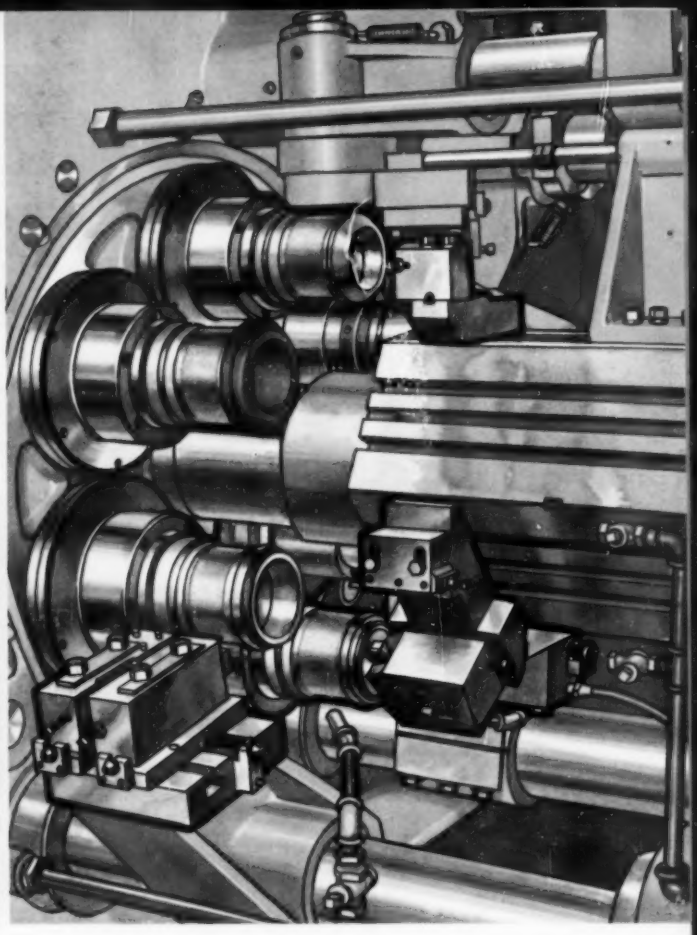
For the first time machines of this type can be used as building block units. Their clean-sided design permits any number of self-contained machines, each with one or more spindles, to be arranged side by side and operated as a single unit. They also may be operated with equal efficiency as individual machines. Parts can be inverted on adjacent machines or on adjacent spindles of the same machine.

In order to take the fullest advantage of the precision inherent in cam control, long linkages between cams and slides have been eliminated. A pair of cams is mounted on a common shaft which is carried *within the vertical slide*. Since all slide actuating forces are contained in the vertical slide, both cams are directly adjacent to the slides they control and no outside forces are imposed on the slide ways. The result is maximum rigidity for heavy cuts coupled with extreme accuracy for close tolerance work.

This unique and eminently workable approach to contour turning and boring results in the highest order of accuracy on even the most complex pieces. Your New Britain Representative can give you details on the nine different models available in this series. For catalog material, write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut





New Britain . . . still the best Chucker you can buy

We're not unhappy about the fact that for years, in many plants, the name New Britain has been synonymous with chuckers. New Britain Chuckers have turned out literally millions of pieces of work for practically every major industry in the world. This is less important to the prospective buyer of one of these machines, however, than the capabilities of these machines today. How do they stack up against other chuckers or even other types of machines capable of doing similar work? Pretty well, we think.

New Britain's open-end design still can't be beat for unlimited accessibility to the tooling area. This same wide-open feature makes it doubly more practical to adapt these machines to automatic loading and unloading.

The unusual combination of longitudinal and transverse forming motions is another unbeatable New Britain feature. The massive forming arms on New Britain Chuckers allow heavier cuts and cuts of much greater complexity. This ability to do more work can eliminate the need for second operation machines in many instances. For really complex work, two chuckers set up side by side, as shown here, each doing one side of the piece, can smooth the way for high production. Less complicated work can be set up to perform both sides of the same piece on a single machine.

These massive machines provide the tooling combinations, spindle speeds and power to perform the widest possible variety of work. Their basic design will stay new for years to come, continuing to provide profitable operation. You may know New Britain Chuckers, but you may not be fully aware of the improved series presently being offered. Why not call your New Britain Representative or contact us at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division · New Britain, Connecticut

Why the Die Maker Prefers PRODUCTO Die Sets

Volkert Stampings, Inc.

The die maker likes to work with Producto Die Sets

He knows Producto die sets are easy to assemble —especially those equipped with the unique new Qwik-Fit Guide Pins*.

He has confidence in the consistent accuracy of Producto sets. He has found that they always align his dies correctly.

He knows he can choose from a variety of thicknesses the Producto die set that meets the strength requirements of his die.

He favors Producto die sets because they are dependable. They will perform on the press as well as they did in tryout.

He likes the attractive, streamlined appearance of Producto sets. They make his dies look better and increase his pride in these products of his craftsmanship.

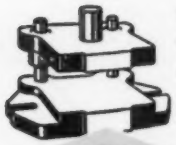
*Patent Pending

He knows that a nearby Producto warehouse can supply any catalog die set he needs...and that orders for specials are promptly processed. He can count on having the die set by the time he needs it.

The die maker has found that all of his requirements are met by Producto die sets. You will, too, when you place your order with Producto.

DIE SET DIGEST, our eight-page quarterly, contains valuable data for designers, makers and users of dies. Write to have your name added to mailing list.

THE PRODUCTO MACHINE COMPANY
925 Housatonic Ave., Bridgeport 1, Connecticut



Wherever die sets are used

PRODUCTO

PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

Shop Superintendent—Kennametal Carbide Engineer—Machine Operator

3-man team solves operating problem

...standardized on one insert for all tools —increased production—reduced downtime

PROBLEM: Original carbide insert (not Kennametal), used in machining a wide range of alloy steels on Gray double-cut planer, had complicated shape; could be used only in special head; different inserts were required for other heads. Thin cross section resulted in costly downtime due to breakage.

SOLUTION: Simplified change in tool geometry, recommended by 3-man team, permitted use of Standard Kennametal* carbide insert.

RESULT: Required only one type of Kennametal insert for all tools. Reduced downtime through increased thickness of insert. Provided easier indexing and greater depth of cut. Insert cost for new setup is 60% less than previous insert cost.

That's the kind of product and service that you can get through your Kennametal carbide engineer.

Thoroughly trained in carbide products, he devotes his time exclusively to the sale and application of Kennametal hard carbides . . . and is well qualified to provide on-the-spot analysis and recommendations. If your job requires unusual or special design, engineering and application service, your Kennametal man will make our headquarters engineering and manufacturing facilities available.

Depth of on-the-job experience —plus the continuing development of a variety of tungsten, titanium, and tantalum carbide grades—has lead to the use of Kennametal compositions in practically every industry. And our product development group, by working in close cooperation with customer personnel, keeps coming up with new tooling and carbide grades to meet the ever-changing needs for machining new and difficult alloys and for machining at higher speeds and closer tolerances.

Helping you get the best tool on the job—whether a standard or a special —is the Number 1 assignment of your Kennametal Carbide Engineer. Why not let him help you plan a Top Tooling program aimed at greater profit on every job. Just call him or write KENNAMETAL INC., Latrobe, Pa.

*Trademark

33589

INDUSTRY AND KENNAMETAL ...Partners in Progress

REMEMBER?

Remember when a machine tool purchase was so simple that a company owner and his assistant would merely get together to decide if a new tool would be handy?

Today, justification of such purchases demands detailed study and frequently the use of accounting machines or computers. Then, with proof in hand, management is ready to decide with confidence.

WIEDEMANN TURRET PUNCH PRESSES — the only engineered short run method of accurately positioning holes, notches and other openings in sheet metal or plates — have proved their exceptionally quick pay-off value. Reductions of 60% to 90% over old methods are commonplace. One company which makes computers paid for its Wiedemann with savings from a single job of three months duration.

Let Wiedemann show the profits you may realize. Just send drawings of your components which are pierced. We will completely analyze them and determine actual production time. Write today for a copy of "Behind the Scene Savings" — outlining 16 major phases of plant operation in which savings can be made.

From the versatile 150 ton R-15 down to the hand operated R-2, there's a Wiedemann for your short run piercing requirements.

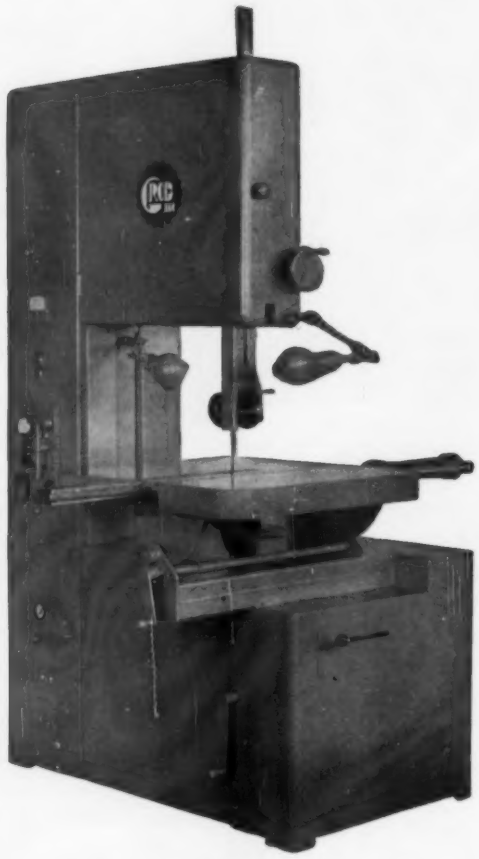
WIEDEMANN

WIEDEMANN MACHINE COMPANY
Gulph Road • King of Prussia, Pa.

GROB SPELLS THE DIFFERENCE IN BAND SAW MACHINES

The new GROB 24" universal band saw has all the famous GROB features:

Quality • Efficiency • Durability • Strength
Utility • Low Maintenance • Reasonable Cost



- Speeds infinite from 35-12000 FPM covers both cold and hot sawing
- Variable drive 3-speed transmission with precision rolled gears and splines transmits 15 HP
- Hydraulic table feed

See the difference demonstrated in our dealers' showrooms

or

Write GROB INC. for complete specifications

GROB also manufactures a complete line of:

BUTT WELDERS
FILING MACHINES
GEAR ROLLING MACHINES

GRAFTON, WISCONSIN

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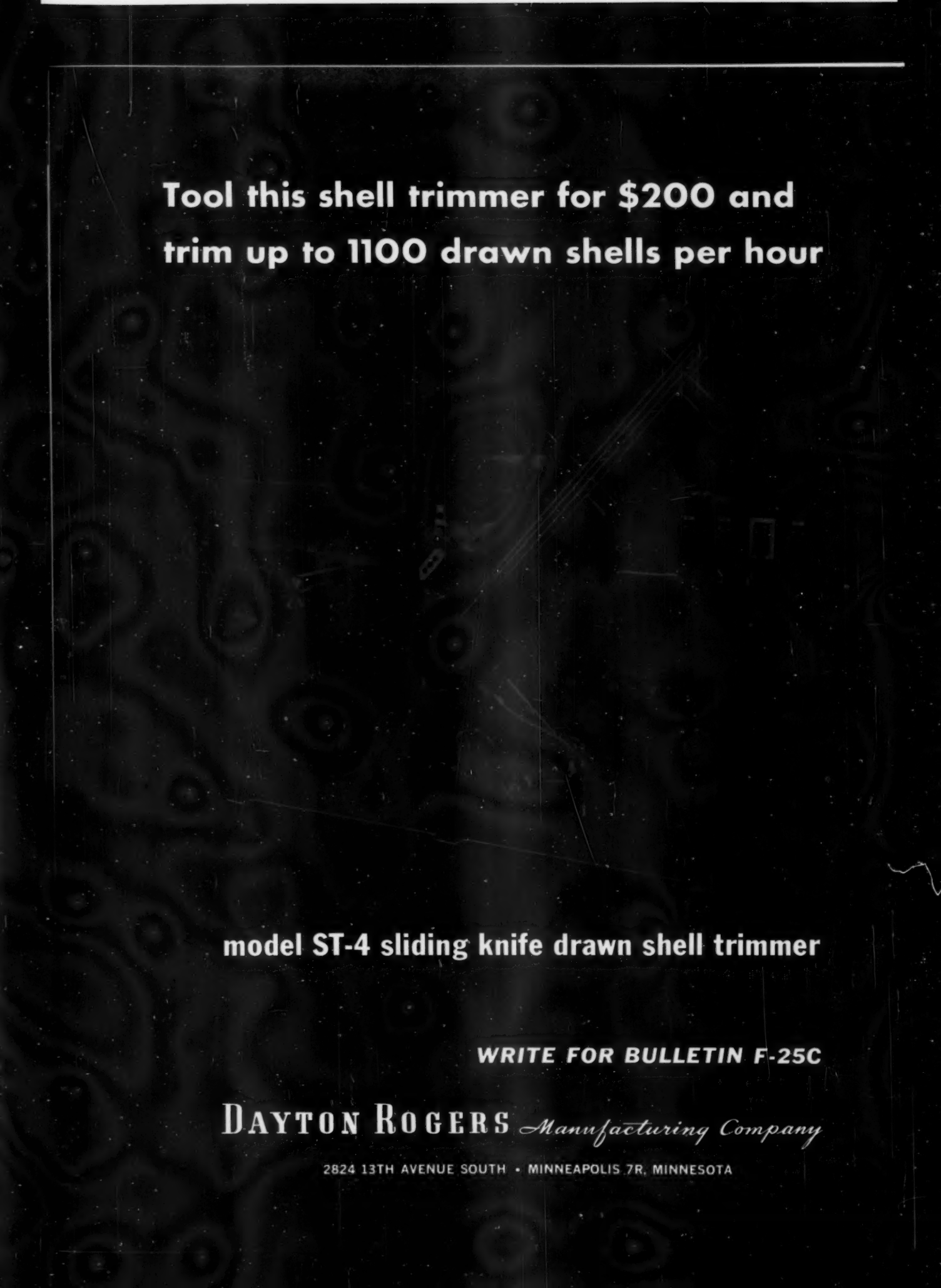
Use Reader Service Card, CIRCLE 41 →

Tool this shell trimmer for $200 and trim up to 1100 drawn shells per hour

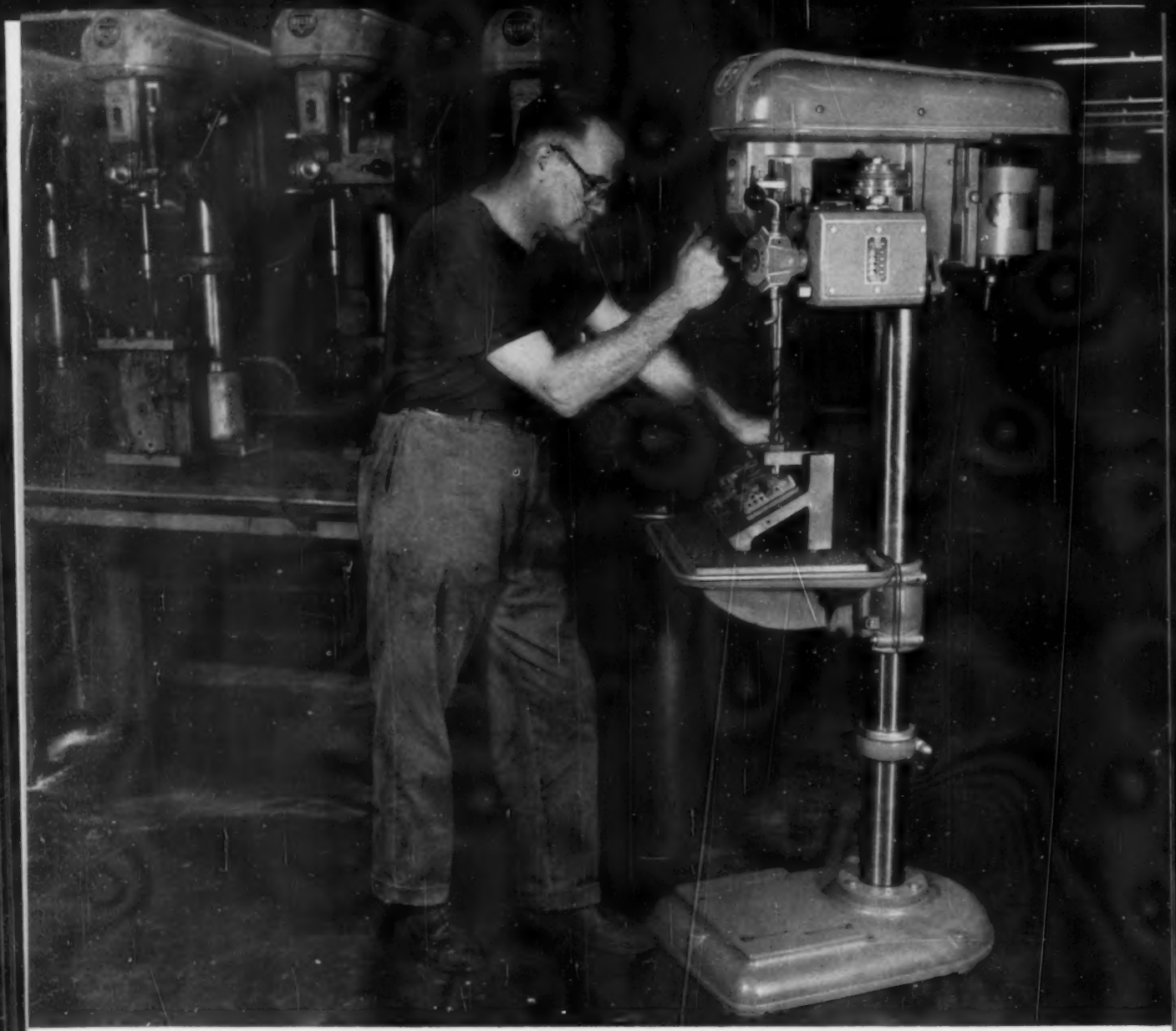


model ST-4 sliding knife drawn shell trimmer

WRITE FOR BULLETIN F-25C

DAYTON ROGERS *Manufacturing Company*

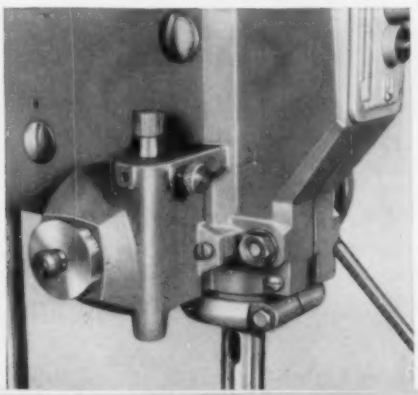
2824 13TH AVENUE SOUTH • MINNEAPOLIS 7R, MINNESOTA



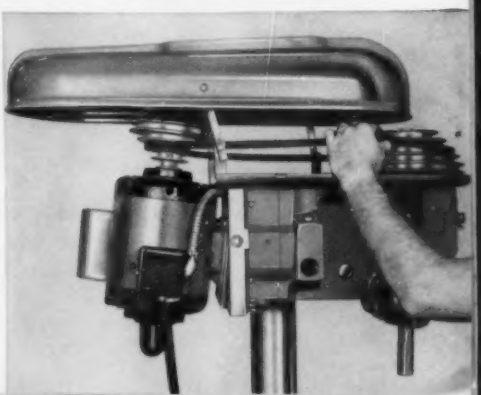
ALL NEW Capacity—Equipped with exclusive Rockwell Power Feed (tested through 750,000 drilling cycles) the all new 17″ drill presses handle many production jobs ordinarily done by costly, fixed equipment. In addition, they offer portability that can be utilized to perform extra drilling operations on limited runs or to relieve production line bottlenecks.

ALL NEW Interference-free Guard
—Tilts up and back out of the way giving operator plenty of room to make belt and speed changes quickly, easily. Three specially designed supports and a stop hold steel guard in "up" position, built-in clips automatically lock guard in operating position when closed.

ALL NEW Internal Depth Stop Mechanism—A new concept in depth stops that eliminates bottom-of-stroke quill deflection which causes excessive drill breakage and downtime. Convenient adjustment knob permits fast, one hand operation, locks in position to stop pinion shaft at same depth through repeated cycles.



ALL NEW Pivot-type Motor Mount
—Assures full release of belt tension before changing from one pulley speed to another, delivers longer belt life and eliminates possibility of damage to the belt. Maintenance of proper running tension on belt at all times prevents undue wear on bearings.



You can do more with these

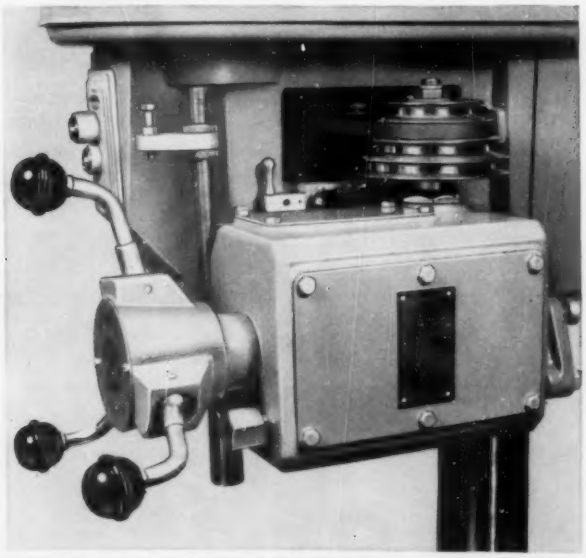
ALL NEW DELTA 17" DRILL PRESSES

Here is a major engineering advance from Delta to give you increased drilling accuracy, more job flexibility and greater operating economy. You can choose the machine best suited to your needs from 76 models in a complete line of 17" drill presses that incorporate the most up-to-date performance features available.

These drill presses are completely new—not merely improved or re-styled—but actually re-designed to deliver consistent precision operation under the most rugged work loads with little or no maintenance.

With the introduction of this all new 17" drill press line, Delta continues to provide the high quality of product that has made it the leading name in drill presses for over 31 years. Your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages) will gladly demonstrate how these 17's can save you dollars, hours and material. Why not call or see him soon!

FREE BROCHURE—Complete specifications and details on the full line of all new 17" drill presses and accessories. Simply write: Rockwell Manufacturing Company, Delta Power Tool Division, 620B N. Lexington Ave., Pittsburgh 8, Pennsylvania.



ALL NEW Rockwell Power Feed—Available as original equipment or as an accessory on every model, this advanced development in mechanical power feeds gives you: a front mounted pilot wheel for one hand operation and "flick of the wrist" control of feeding; infinitely adjustable drill point pressure and a built-in feature that permits remote control. For semi or fully automated operations, power feed can be electrically, hydraulically, pneumatically or mechanically interlocked with other machines.

CHOOSE FROM 76 MODELS

Selection includes: floor, bench or multiple spindle machines equipped with standard or production table, standard or Rockwell Power Feed, key chuck or tapered spindle, high or slow speed.

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

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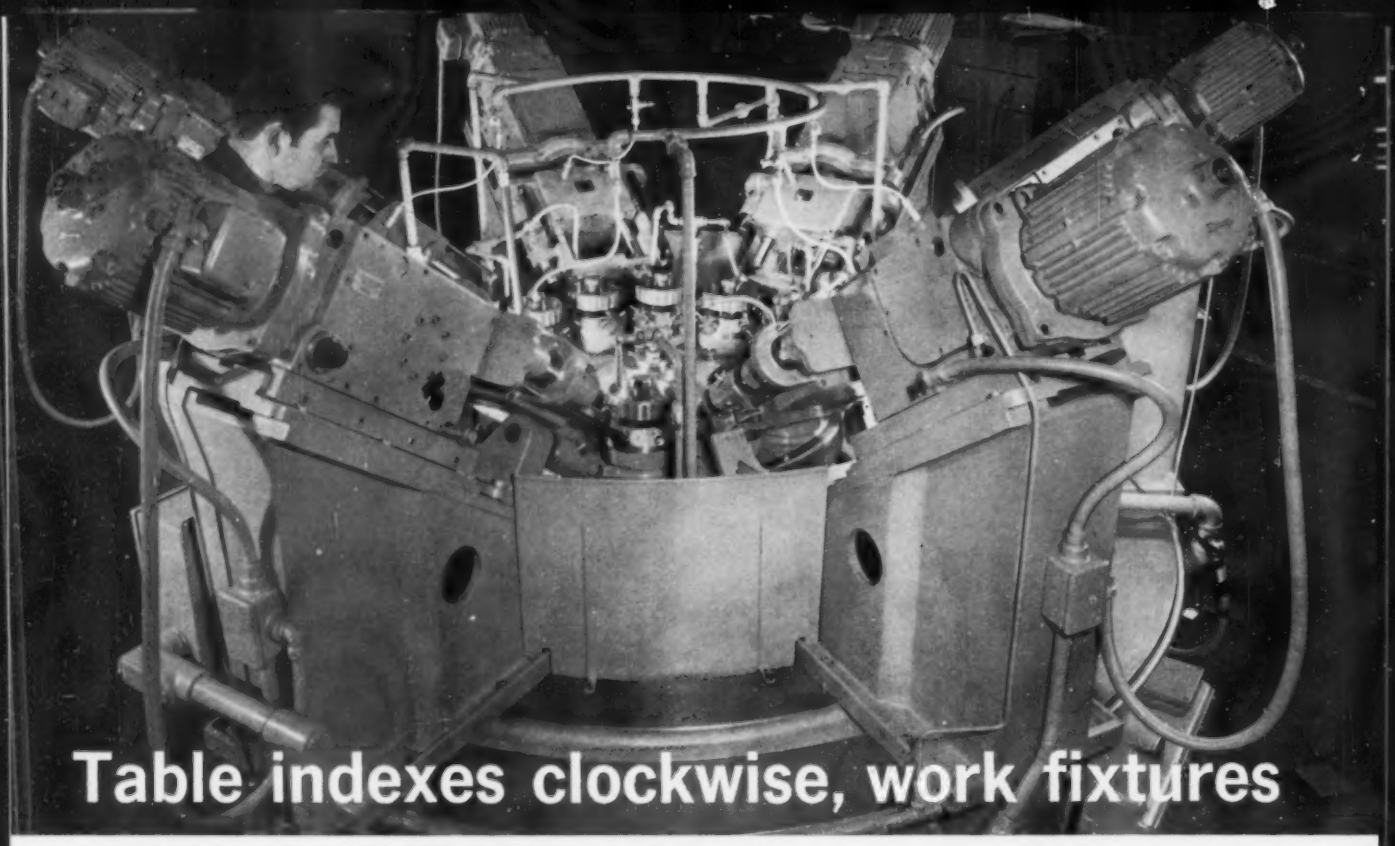


Table indexes clockwise, work fixtures counterclockwise for 6 holes 60° apart

Kingsbury machine drills and c'bores 135 steel forgings per hour gross

Problem: C'bore and drill six angular holes 60° apart in a forged steel gear.

Solution: Six drilling units with two-spindle heads are mounted on angular columns 60° apart on a circular base. An index table holds 12 work fixtures that do not turn with reference to any fixed point. As the table indexes clockwise 30°, each fixture indexes 30° counterclockwise. The work remains clamped as it indexes.

Each unit operates two tools downhill at a 27° angle. The first tool counterbores .1562 diam. at one station for an accurate start. The second drills .0937 diam. through at the next station. The operator changes parts in his fixture while the units perform their automatic cycles. Two tools operate at the same time on the part at the rear station.

Uniform Parts that Gage Maybe this seems simple. But it takes some doing to . . .

— build 12 fixtures that are exact duplicates, each one to hold the work firmly and accurately;

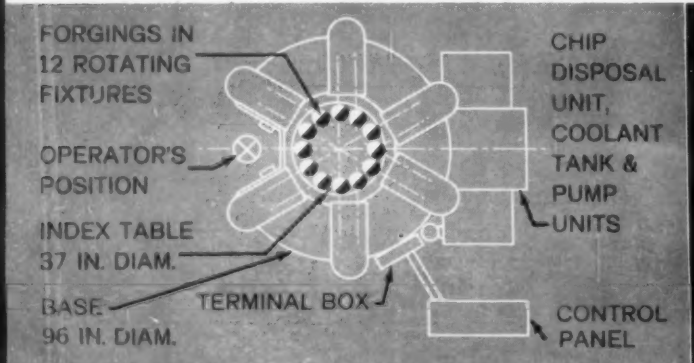
— remove backlash from the gears that index the fixtures;

— start angular holes straight and in exact position.

We specialize in solving such problems. Our machines have good basic design and accurate rugged construction to produce uniform parts that gage.

May we make you a proposal? You can then place one order for the entire machine and make us fully responsible that it meets your specifications. Kingsbury Machine Tool Corp., Keene, New Hampshire.

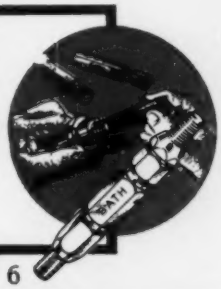
KINGSBURY MULTI-UNIT AUTOMATICS


FORGINGS IN 12 ROTATING FIXTURES
OPERATOR'S POSITION
INDEX TABLE 37 IN. DIAM.
BASE 96 IN. DIAM.
TERMINAL BOX
CHIP DISPOSAL UNIT, COOLANT TANK & PUMP UNITS
CONTROL PANEL

FLOOR PLAN

FORGED STEEL GEAR FOR TRANSMISSION

BATH *Tap'n Gage* TIMES



A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 6

Subject: Tapping the Difficult to Machine Materials:

The "missile age" has brought about the development of new materials designed to withstand the extreme stress, heat and strength problems inherent in jet engines, high speed aircraft, missiles and similar military hardware. These materials are classed as "difficult to machine" in comparison with the common types of steels, irons and light alloys.

General Tapping Data

It is essential that all of the rules for good machining practice and tapping procedure be followed. Initial design specifications for threaded holes should favor the tap wherever possible. A copious supply of coolant must be provided and the coolant temperature should be maintained as low as possible. Tapping speeds should be reduced considerably in comparison with ordinary practice.

Titanium and Titanium Alloys

The basic characteristics of this material are low volume specific heat and low thermal conductivity. These thermal properties are best combatted by reducing the rate of heat generation. In tapping, heat generating friction is minimized by eccentric relief in the threads, additional chamfer relief, interrupted threads and increased back taper.

Hand taps with the standard number of flutes and chamfers of 4 to 8 threads have proved satisfactory. Bottoming holes may require series or sets of taps. Spiral pointed taps are satisfactory for through holes not exceeding 2 diameters.

Abrasive wear and galling can be reduced by case surface and oxide treatments. Tapping speeds vary from 40 SFM for the softer grades down to 10 SFM or less for the toughest grades. A maximum 65% of thread height is suggested and cutting fluid should be an activated sulpho-chlorinated oil. If standard taps are not satisfactory, Bath Type "R" or "RR" are recommended.

High Tensile Steels (Super-Strength Steels)

The basic characteristic of these materials is the hardness after heat treating which ranges up to 58 Rockwell C. Tapping difficulties vary with the analyses even though Rockwell readings may be the same. Tap recommendations for these materials must include careful consideration of cut per tooth. Taps with four flutes and 6 to 8 threads chamfer have given best results. A cutting face angle which is approximately radial (0° rake) should be used. Tapping speeds should not exceed 10 SFM and cutting fluid should be activated sulpho-chlorinated oil, generously applied. If standard taps are not satisfactory, the use of special high Rockwell high speed steels such as Bath "N Steel", will be required.

High Temperature Alloys (Superalloys)

The basic characteristic of these materials is their tendency to work harden. Hardness and resistance to cutting varies with each alloy group. Cutting speeds and tap design must be tailored to the particular alloy. A cutting face hook of from 0° to 10° should be used. The harder the material the lower the hook. Chamfers should be from 3 to 5 threads and thread relief should be used to reduce work hardening due to rubbing. Tapping speeds must be kept low and in extreme cases are in the 5 to 10 SFM range. Thread height should be kept as low as possible and activated sulpho-chlorinated cutting oil is recommended. If standard tap materials are not satisfactory, Bath "N Steel" will be required.

Stainless Steel

Free machining grades are not much more difficult to tap than ordinary mild steels. The difficult grades require taps designed with free cutting characteristics. Thread relief, interrupted threads, hook angles of 8° to 12°, increased back taper and certain surface treatments help to reduce friction. Spiral pointed taps give good results where applicable. Tapping speeds are in the range 10 to 40 SFM and activated sulphorized and chlorinated oils are the most generally used coolant. If standard taps are not satisfactory Bath Type "R" should be specified.

For further information on this subject, fill out and mail attached coupon with 25¢ for technical brochure "Milling, drilling and tapping the difficult to machine materials" — published by the Metal Cutting Tool Institute.

Clip and mail coupon NOW!

John Bath & Co., Inc., 28 Mann Street, Worcester, Mass.

Please send a copy of brochure "Milling, drilling and tapping the difficult to machine materials"—for which I enclose 25¢.

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This Missile Part demands precision hole tapping

...gets it with Gardner-Denver "Tru-Thread" Tapper.

Here's the story: Rigid specs at Norris Division of Norris-Thermador Corp. call for tapping 7/16-20 Class 3 threads. It is vital that the depth of thread be held within .005". To meet these tough requirements, Norris-Thermador put a new Gardner-Denver "Tru-Thread" Tapper to work.

Highly Portable. This air-powered, positive-feed tool precision-taps clean, accurate threads in a hurry. One man can easily take it to the work—freeing expensive machine tools for other jobs, increasing efficiency.

"Controlled-pitch" lead screw feed prevents tearing or stripping of threads and tap breakage . . . enables this tool to produce Class 3 threads consistently. Single control starts completely automatic cycle. The Gardner-Denver "Tru-Thread" Tapper is a ready solution to precision tapping problems in hole sizes from No. 2 to 1" diameter. Request Bulletin 93-31.

Something else: Ask a Gardner-Denver Production Machines Engineer to show you how this versatile air tool can be incorporated into a *fully automatic* unit for precision, low-cost production.

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EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

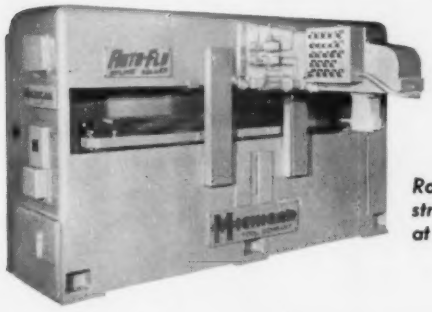
Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario

SOLUTIONS TO GEAR PROBLEMS

PROBLEM: TO BOOST TRACTOR AXLE SPLINE STRENGTH WITHOUT HIGHER COST

To increase strength of tractor axle shafts produced by a major manufacturer without increasing diameter, Michigan recommended the use of a Roto-Flo machine to cold roll the splines. This resulted in a 60% increase in torque load capacity due to the cold working at the normally weakened section. The "chipless machining" process reduced stress concentrations by 37% and increased production rate three-fold over the slower previous hobbing method. The same machine is used for different sizes of shafts. There were also major savings in tool costs over hobbing.



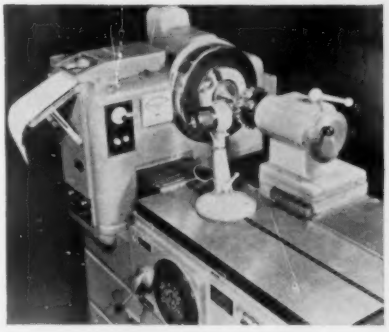
Roto-Flo gives stronger splines at lower cost

PROBLEM: NEEDED FAST ACCURATE INDEXING IN ¼ DEGREE INCREMENTS

Operations performed on a missile part required extremely accurate indexing in quarter degrees. Precision indexing tables used before required special gage blocks, trigonometry tables and a lot of time. Michigan's answer was a double table version of its Milichex rotary indexing table. This new version, Model M2X-900, provides instant indexing to ¼ degree settings with an accuracy of ¼ second of arc. No gage blocks or trig tables are needed. Operator merely indexes upper and lower tables to proper settings and Milichex automatically locks into exact angular position.

This Milichex indexes in ¼° increments

PROBLEM: 100% CHECK OF GEAR TOLERANCES TO TENTHS IN PRODUCTION

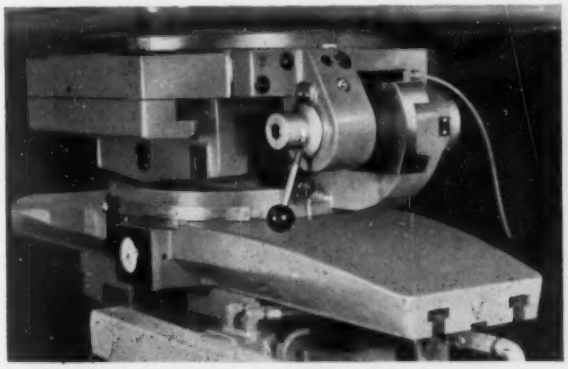


Production lead checking to laboratory tolerances on a 1218-A

A jet engine production bottleneck was the time required to accurately check the lead angle of gears to 0.0003 inch. A Michigan Sine Line 1218-A Lead Checker answered this need. Originally a 'laboratory' type checker, the machine with its precision optical system eliminates the need for "operator feel", records all checks, has the ruggedness for continuous production checking.

PROBLEM: TO SHAVE ANY COMBINATION OF CROWN & TAPER ON SAME MACHINE

Solved by a compact attachment for the Mark II shaving machine. Setting permanently installed attachment to scale controls amount of taper. An eccentric bushing in the attachment controls taper independently. For uncrowned untapered gears, both are set to 'zero'. Gears can be tapered or crowned with either transverse or modified underpass method. For spur gears, underpass method can also be used.

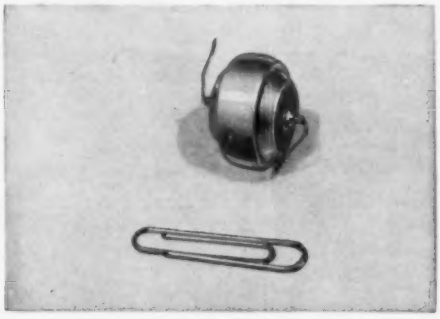


Taper & crown attachment for the Mark II gear shaver

MICHIGAN TOOL COMPANY, 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

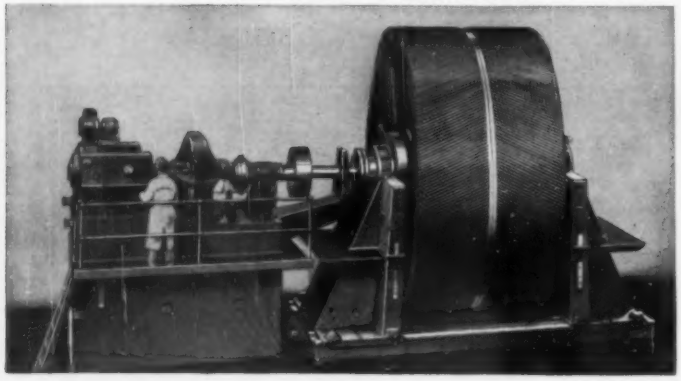
Use Reader Service Card, CIRCLE 47

ROTATION WITHOUT VIBRATION



Over 20 standard models in the Gisholt Balancer line handle parts ranging from the small gyro motor (shown compared to a paper clip) to the massive gear shown in a Gisholt Floor-Type U Balancer.

Accuracy? You can measure vibration as small as .000002" on the small gyro motor using an HS Balancer, and vibration as small as .000025" with the large Type U Balancing Machines.



in rotating parts from ¼ oz. to 100,000 lb.

The Gisholt method is fast and simple . . . eliminates guesswork . . . handles single parts or large production runs at lowest cost.

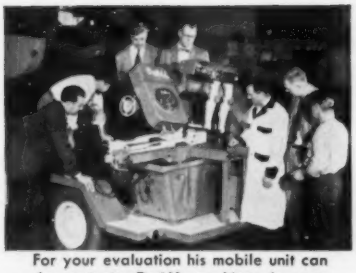
Just load the work and apply rotation. Whether the part requires correction in one or two planes, the angle of unbalance is clearly indicated. The direct-reading amount meter shows how much material must be added or removed — in terms of the correction method most suitable for the work.

Gisholt Balancers are easily equipped with integral correction equipment that permits combining location of angle, measuring of unbalance, correction and inspection in one handling. For full information, call your Gisholt Representative, or write for our Balancing Catalog 1109-C.

GISHOLT
MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

Investigate Gisholt's Extended Payment and Leasing Plans

Turret Lathes • Automatic Lathes • Balancers • Superfinishers® • Threading Lathes • *Factory-Rebuilt Machines with New-Machine Guarantee*



For your evaluation his mobile unit can demonstrate DoALL machines in your plant on your jobs.

Now right at your desk 8 mm. talking pictures show you why DoALL tools and services are best for you.

THE DoALL MAN IS MANY. . .

Your local DoALL metalworking specialist is one of more than 200 trained experts serving American industry. He is backed in depth by another DoALL team of 220 scientific engineers and technicians whose job it is to produce top-quality metalworking tools and keep them operating at peak efficiency in your plant.

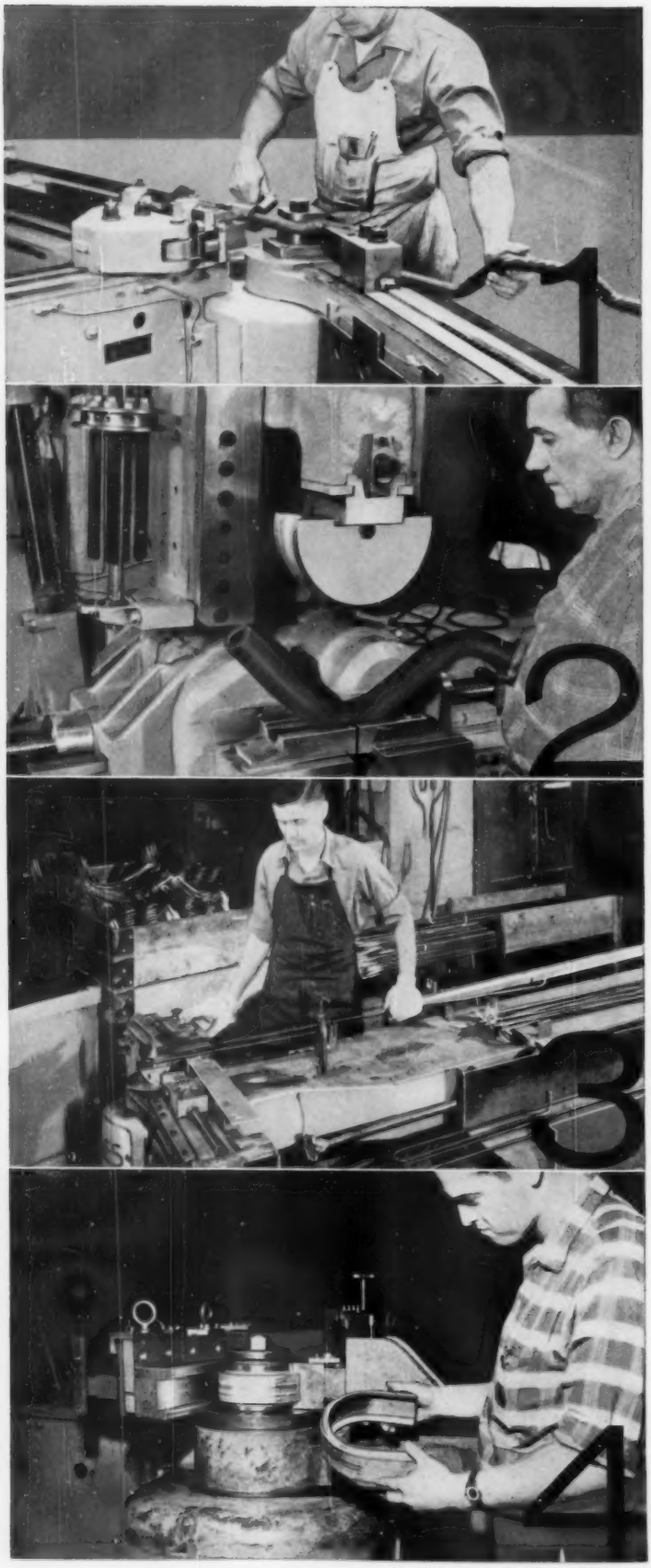
Your DoALL specialist has many fresh, thoroughly practical and tested ideas for increasing your productivity. He comes to you with a wealth of experience and a storehouse of knowledge to help you lower the cost of your machining and gaging operations . . . to give you greater productivity.

Through him it is easy for you to solve your metalworking problems. Call him any day—he is at your command and his services are free!

S-11

This is a typical DoALL Store

The DoALL Company, Des Plaines, Illinois



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LARGE AND SMALL PARTS FROM FORGINGS TO WELDMENTS

. . . are today formed with greater speed, accuracy, and quality by cold bending on Pines Machines. Increased production, improved product quality and substantially reduced costs have resulted for hundreds of fabricators . . . men of vision who have applied the latest in bending machines, tooling, and techniques to the production bending of tube, rod, pipe, sections and extruded shapes.

Call on Pines for assistance in evaluating your bending applications or for a cost analysis . . . no obligation. See how you can cut costs with results such as:

1. Multi-throw crankshafts for farm machinery, formerly forged, are now cold-formed on Pines Model 2 at a savings of 88%.
2. Boiler tubes accurately bent on Pines Model 40-T Bending Press with production increases up to 75% over former method.
3. Heater elements for electrical equipment, previously bent by hand, are now formed on Pines Model ¾ Machine with greater accuracy, improved product quality and a direct savings of 25%.
4. Stainless steel shroud sections for aircraft, formerly purchased as assemblies that were draw-formed and welded, are now produced on Pines Model 4 with savings of $350 for each hour of Bending Machine operation.

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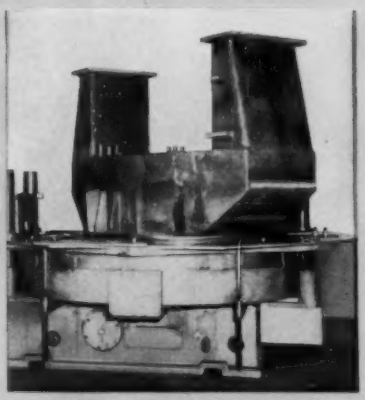
Specialists in Tube Fabricating Machinery 693 Walnut • Aurora, Illinois

A LAPMASTER CAN MEAN BIG SAVINGS...A BETTER PRODUCT

here are more examples of how:

HIGH PRODUCTION RUNS or small lots—both turned out with *consistent* accuracy on a Lapmaster. Day-in-day-out production rates range from a few pieces to thousands per day.

FLATNESS OF .0000116" or less with a micro-inch finish of 2 to 3 RMS is everyday work for a Lapmaster. Uniform accuracy maintained piece-after-piece because conditioning rings automatically keep lap plate flat.



4920 LB. PARTS can be handled—as well as small ⅛" dia. pieces. This 84" dia. weldment for a radar tracking antenna was lapped to a flatness and parallelity within ± .00005" on a Lapmaster Model 84.

TALL and SMALL PARTS AT THE SAME TIME. No expensive fixturing required... in most Lapmaster applications only inexpensive masonite or micarta work holders are necessary. Eliminates danger of stresses and warpage usually caused by clamping during grinding.

EXTERNAL and INTERNAL LAPPING IN ONE OPERATION. Versatility of the Lapmaster is demonstrated in this lapping operation on R. R. air brake parts. Reciprocating mechanism runs small lapping block in and out of work while other parts are being lapped on plate.

SHAPE OR FORM NO PROBLEM. Special lap plate and work holder permit lapping of swing check valve. Other simple attachments and holding devices can be furnished to facilitate lapping of "hard-to-handle" or extremely large parts.

Lapmaster®

...THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

WRITE FOR THE COMPLETE LAPMASTER STORY

Write for bulletins describing the Lapmaster line and chart on measuring flatness.

A product of

Crane Packing Company

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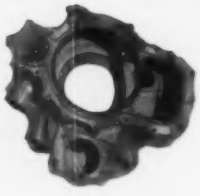
In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

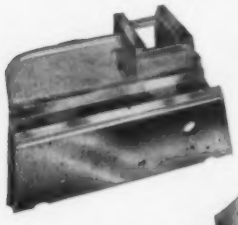
Sundstrand "Engineered Production" Methods

...practical ideas for men who are responsible for manufacturing quality, quantity and profit

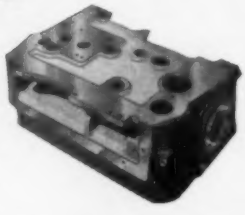
Model OM-3 Omnimil with automatic tool changer — for parts to 2' x 2' x 2'. Larger Model OM-4 handles parts to 4' x 4' x 4'

Savings — aluminum housing milled, drilled, tapped, counterbored in 1.86 hours in 3 setups on Omnimil vs. 12 hours with 29 setups on 29 machines by old method.





Savings — cast iron base drilled, tapped, bored, milled in 7.36 hours on Omnimil vs. 20.4 hours by old method.



Savings — cast iron feed box bored, drilled, tapped, reamed, counterbored, milled in 6 hours on Omnimil vs. 32 hours by old method.

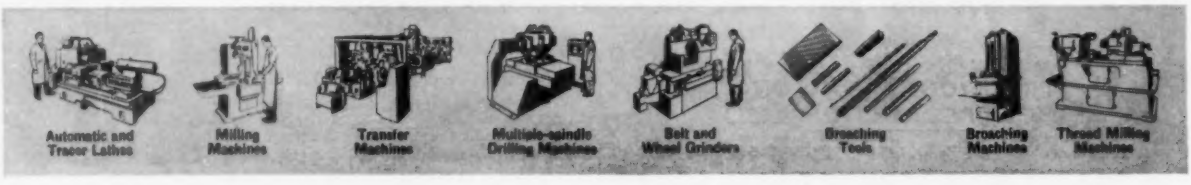
Numerically Controlled Omnimil is a single machine "production-line"

Mills, drills, bores, reams, taps at any angle to exposed faces of workpiece

You can handle on a single Sundstrand 5-axis Omnimil a variety of operations now requiring a battery of different machines. Many parts can be completed in a single setup on this extremely versatile multipurpose machine tool. Machining can be performed at virtually any compound angle and holes can be drilled, tapped, or bored square in respect to any angular face. Setup, work handling, and production time on many parts are cut as much as 10 to 1 and more over other methods.

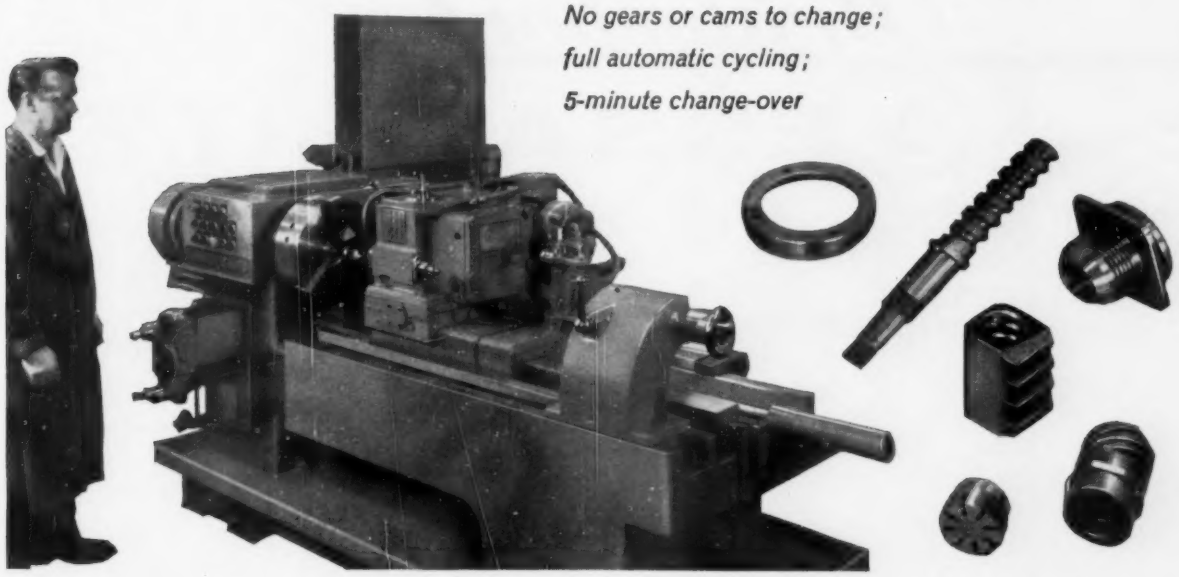
All machine functions, including the optional automatic tool changer available on the Model OM-3, are under numerical control — positioning or contouring. Maximum savings are effected on short-run production because of ease of change-over. Jigs are eliminated because the machine automatically positions to ±.001" accuracy.

The Omnimil is part of a complete system of standard and special Sundstrand numerically controlled machines designed to suit your production requirements. For details, ask for Bulletin 724-NC.



New thread milling machine dial-adjustable for leads up to ½"

No gears or cams to change;
full automatic cycling;
5-minute change-over



The Sundstrand universal automatic thread milling machine with sine bar adjustment speeds work, improves accuracies, reduces scrap loss on a wide range of threading operations — including those difficult, costly, or impractical by other methods. It mills internal or external threads, right or left hand, straight, tapered, or special, with an infinite range of leads from 0 to ½".

The machine uses multiple thread cutters with no lead but with the desired pitch and thread form. The sine bar mechanism traverses the cutter to produce the lead.

No special operator skills are required to produce precision work. Fast 5-minute setup makes the machine ideal for short or long runs.

Four models handle workpiece lengths up to 24", 48", 72", and 96". Optional accessories include: taper cutting attachment; facing attachment; power positioning of cutter head; tailstock; steady rest for 1" to 6" diameter parts. Ask for Bulletin 724-TM for complete information.

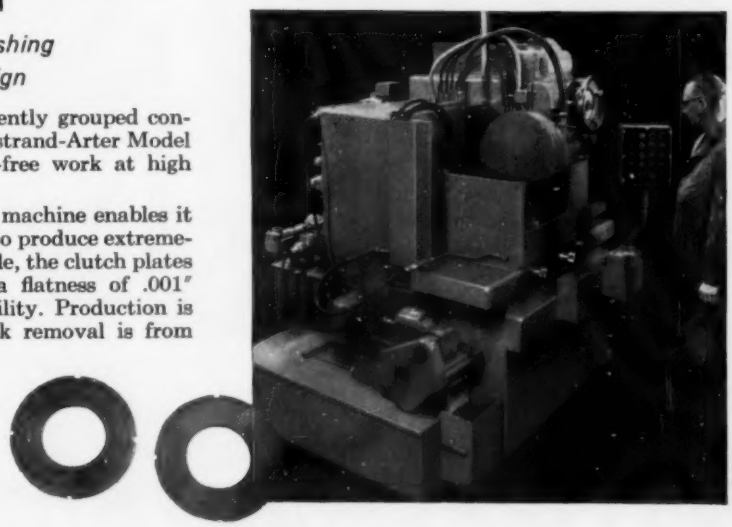
Hydraulic rotary surface grinder has easy-to-reach controls for fast operation

Heavy cuts and precision finishing made possible by rigid design

Completely automatic cycling, plus conveniently grouped controls, make it easy for the operator of a Sundstrand-Arter Model E rotary surface grinder to produce error-free work at high production rates.

The extremely rigid, precision design of the machine enables it to take heavy stock removal cuts, as well as to produce extremely fine finishes to close tolerances. For example, the clutch plates illustrated are ruff and finish ground to a flatness of .001" total indicator reading with .005" repeatability. Production is 45 sides per hour, at 85% efficiency. Stock removal is from .009" to .012".

Two models are standard with nominal chuck diameters of 12" and 16". A Sundstrand Power-Grip magnetic rotary chuck is standard equipment. Ask for Bulletin 724-G for specifications and details.



SUNDSTRAND

SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION

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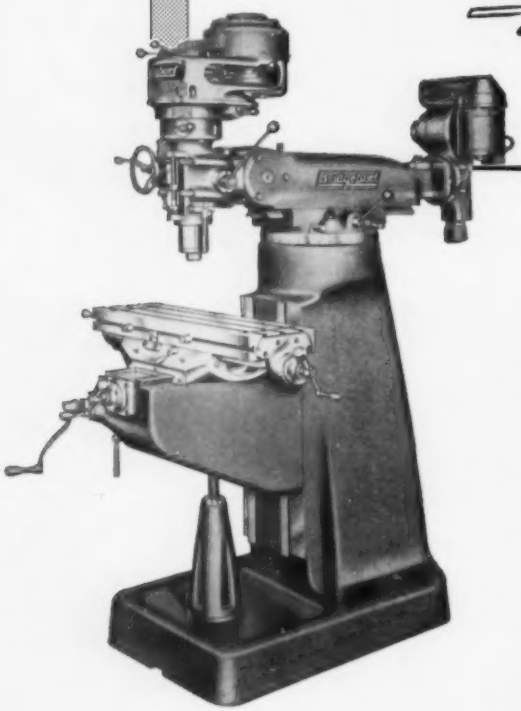
VERSATILITY



"The Most for the Least"

All the following operations are performed on BRIDGEPORT TURRET MILLING MACHINES, at all angles of the work, without changing set up:

Milling	Slotting
Drilling	Cherrying
Boring	Fly Cutting
Right Angle Milling	Profiling

Hydraulic Duplicating

Obviously this is **Versatility.** To which Bridgeport offers maintained precision at all production speeds, profitable production whether in tool room or on the production line. Attractive returns are assured through a most modest investment. This is why Bridgeport stresses "The Most for the Least" wherever these highly developed machines are used.

For further details consult your nearest dealer or us direct.

Bridgeport® MACHINES, INC.

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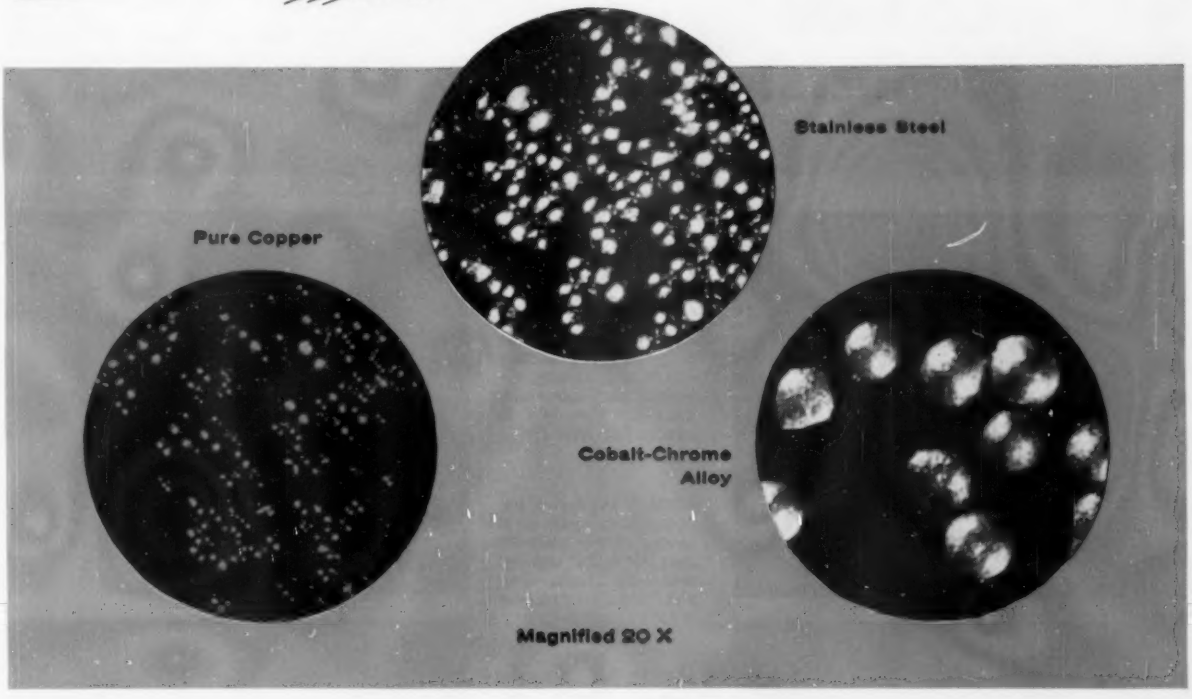
Manufacturers of High Speed Milling Attachments and Turret Milling Machines

TOCCO Induction Melting provides precise control for new metal powder process



A new metal atomization process produces fine, pure, high-temperature metal and alloy powders of accurate particle size and shape. It was developed by Federal-Mogul Division of Federal-Mogul-Bower Bearings, Inc. at their Research Laboratories in Ann Arbor, Michigan.

A very important part of this process is the ability of the Tocco melting equipment to produce clean, molten metal, at the exact temperature required, quickly and efficiently. Three interchangeable Tocco melting furnaces used with the Tocco 100 KW 3 KC motor generator and furnace control provide the versatility necessary to enable Federal-Mogul to process many different metals without expensive, time-consuming change over.

Regardless what your metal heating problem is—melting, heating for forming, heat treatment—it will pay you to investigate Tocco application engineered induction heating.

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today— NEW FREE Bulletin

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Please send copy of "The Case for Induction Melting"

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Heavy Equipment Manufacturer

doubles production — cuts tool inventory 75%

with ADAMAS Carbide Products!

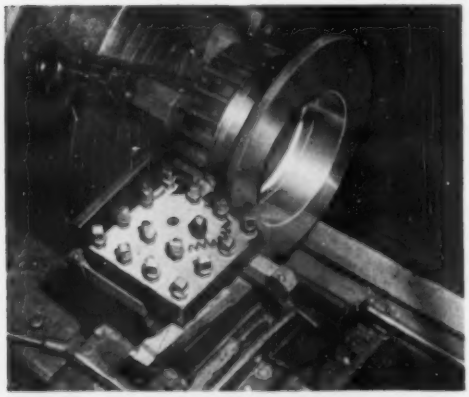
GET CONSISTENTLY HIGHER PERFORMANCES LIKE ESSICK

Two years ago Essick Mfg. Co., Los Angeles, was concerned with production lags, and excessive carbide tool costs and inventories. Essick tried various sources for inserts and holders but the tips would either pull out or fail to control the chip.

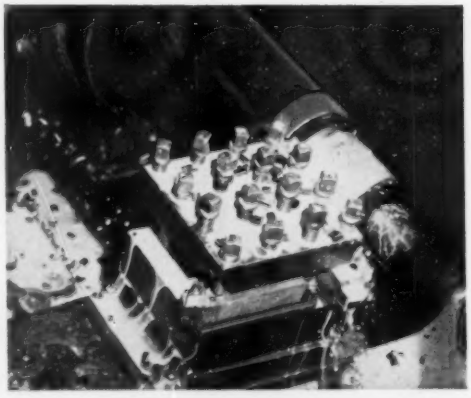
An Adamas advertisement influenced Essick's M. L. Taylor, Gen. Supt., and R. E. Drake, Div. Supt., to investigate Adamas carbide inserts and Dex-A-Tools. The adjustable chipbreaker control principle designed into the tool indicated a possible solution to Essick's problems.

Adamas Dex-A-Tools with Grades 434 and 548 inserts now handle practically all Essick applications with heavier feeds and higher speeds, and closer tolerances than those obtained with competing tools and inserts. Essick has reduced downtime . . . substantially increased output . . . lowered inventory of carbide and tools by 75%.

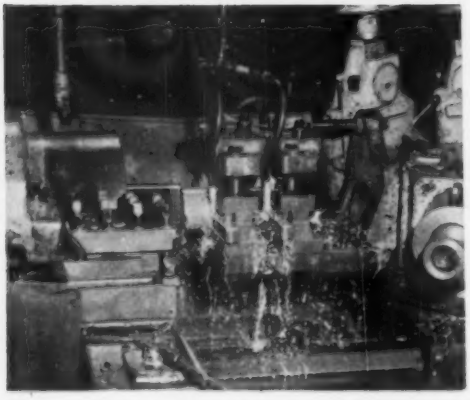
Roy Houck, District Manager — Adamas' Los Angeles office, furnished tool engineering assistance in the development of these applications.



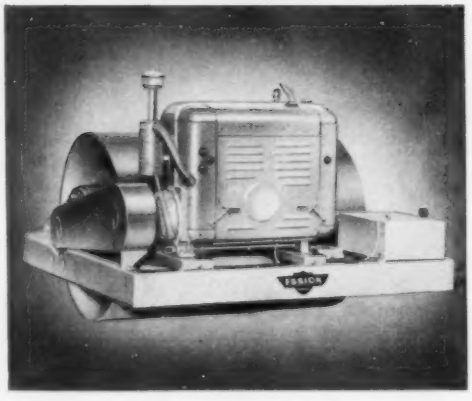
ADAMAS Dex-A-Tool and Grade 548 triangular insert turning bearing housing 11.00" diam. This operation now takes 20 minutes . . . previous performance with competitive tools took 30 minutes. Time saved 33⅓%.



ADAMAS Dex-A-Tool and Grade 434 triangular insert turning vibrator shaft OD from 2⅛" to 1⅛" with one pass using a cross slide. Unit production rate rise 50-65%.



ADAMAS Dex-A-Tool and Grade 434 triangular insert turning vibrator shaft OD from 4⅛" to 3⅛" with one tool, and from 3⅛" to 2⅛" simultaneously with the second tool. Production rate rise 50-65%.



ESSICK Vibrating Compactor . . . One of the many pieces of heavy construction equipment machined with Adamas Carbide Dex-A-Tools and throwaway inserts.

We would be glad to show you how Adamas Carbide products can help reduce your manufacturing costs. For more information, literature, and prompt engineering assistance, write direct to:

FREE — *Ask for your copy of New Adamas Price List PL-960*

Producers of Tungsten Carbide Tools, Tool Tips, Dies, Wear Parts, Dex-A-Tool, Dex-A-Mill

ADAMAS CARBIDE CORPORATION
KENILWORTH, NEW JERSEY

PROGRESSIVE CARBIDE USERS SELECT BY *Performance* — NOT HABIT!

let's talk CAPACITY

CAPACITY, what does this represent in terms of dollars to a prospective buyer of metal cutting machines.

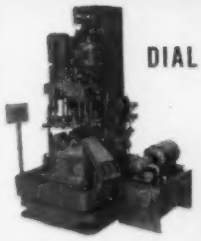
We at **MICHIGAN** feel that manufacturing **CAPACITY** is an important asset and most beneficial time saving aid available. We constantly strive to improve our manufacturing and assembly methods, this in turn increases our **CAPACITY.** The ability to manufacture machines in less time, results in a low product cost to the customer.

- Modern Building.
- Excellent plant facilities.
- Complete engineering.
- National sales staff.
- Blueprint and duplicating departments.
- Manufacturing facilities to machine every detail in all of our many components.
- **MICHIGAN** designs and fabricates electrical, hydraulic and lubrication installations.

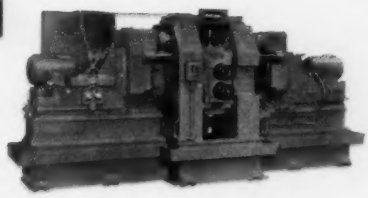
All this represents **CAPACITY.**

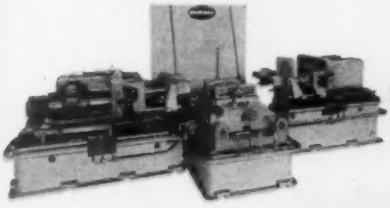
MICHIGAN'S CAPACITY pays off in savings to our customers. If you're looking for a special metal cutting machine of any kind, remember **MICHIGAN**—we specialize in dependable delivery, low product cost and excellent service. Send us your inquiries, we will be pleased to serve you promptly.

DIAL



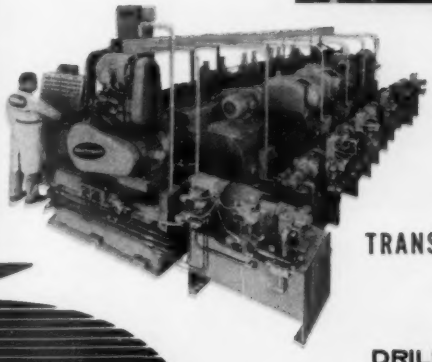
TRUNNION





SHUTTLE

SPECIAL



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DIAL EQUIPMENT
TRUNNION
SHUTTLE
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FIXTURES

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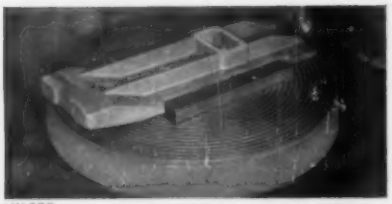
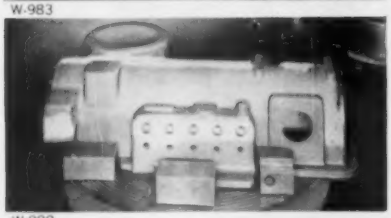


W-983



W-980

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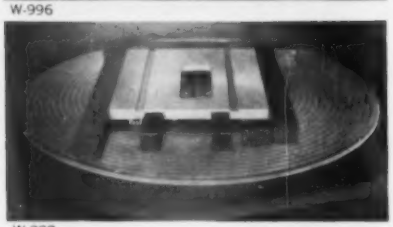
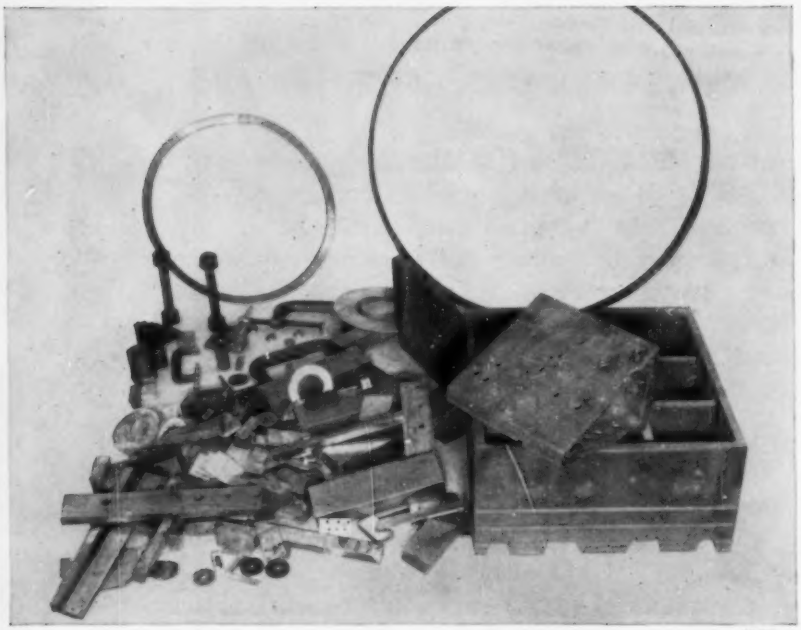
W-996



W-998

BLANCHARD GRINDERS



M-59

Use Industry's Least Expensive Fixtures . . .

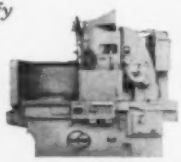
Normally, the Blanchard magnetic chuck will hold ferrous work pieces during the grinding cycle.

But when fixtures *are* needed — for holding irregular-shaped objects, whether ferrous or non-ferrous — you can usually select your "fixtures" from the nearest scrap pile.

For high-speed production, close-tolerance finishes and the most versatile grinding capabilities in existence . . . *put it on the Blanchard!*

Write today for your free copy of "Work Done on the Blanchard", Fifth Edition, and "The Art of Blanchard Surface Grinding", Fourth Edition.

For Best Results, Always Specify Blanchard Grinding Wheels for Blanchard Grinders.



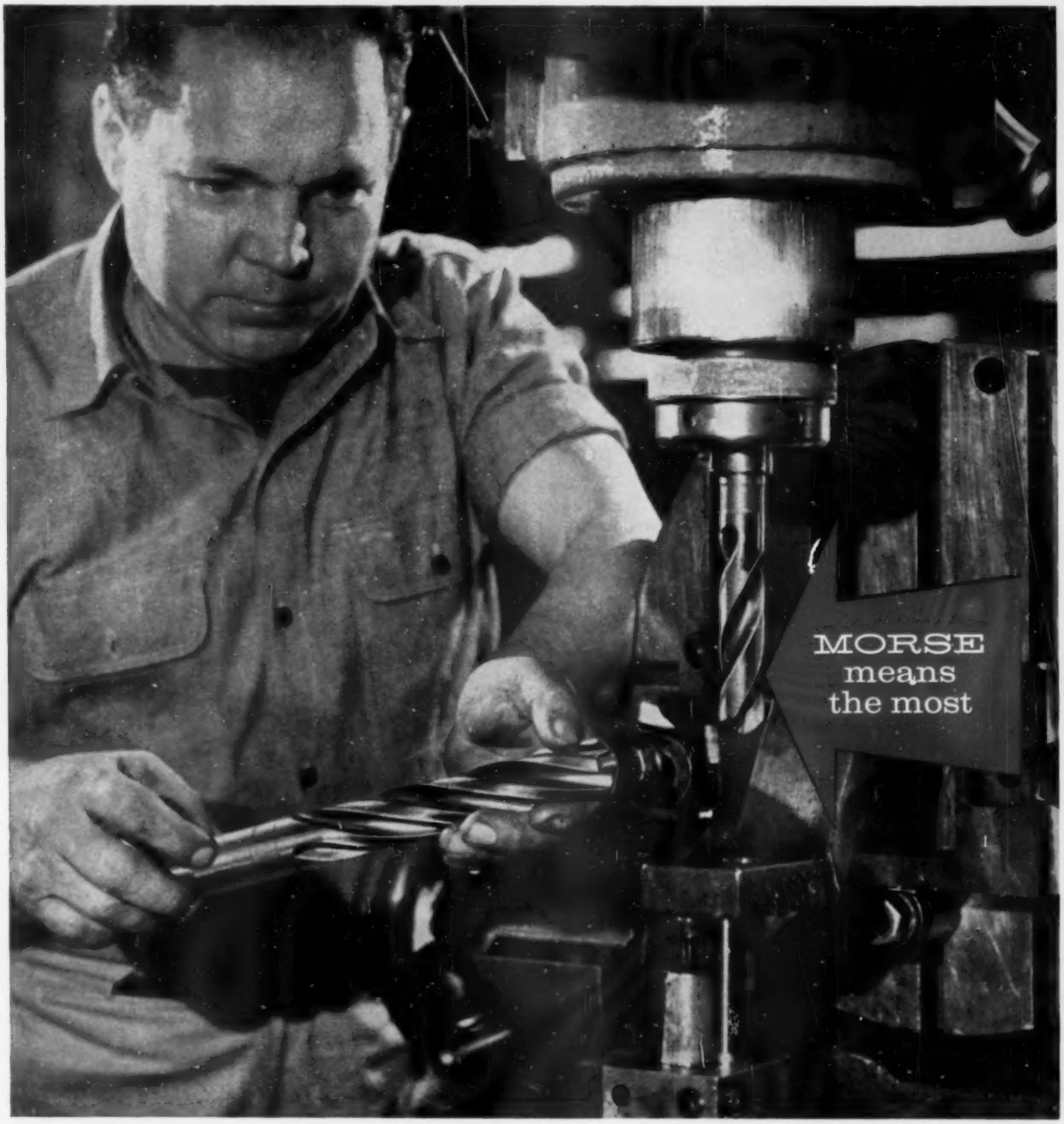
No. 18

PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY

64 State Street, Cambridge 39, Massachusetts

with men who know cutting tools... it's MORSE everytime



TRY **MORSE**... BUY **MORSE**
SEE YOUR NEARBY **MORSE** DISTRIBUTOR

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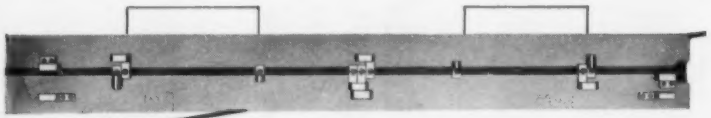
MORE PARTS FASTER with the NEW S-12 series

knee type milling machines

Unquestionably your first impression of the clean, functional styling of these all-new "*S-12's*" will be an immediate feeling of modern precision, strength, stability, and careful, thorough engineering. BUT — there's a lot more to these all-new "*S-12's*" than first meets the eye! There are time-saving, production-boosting features incorporated in this all-new "*S-12 Series*" that make it worthy of your most serious *Consideration and Comparison* if you have any thought of modernizing your plant facilities to increase productivity.

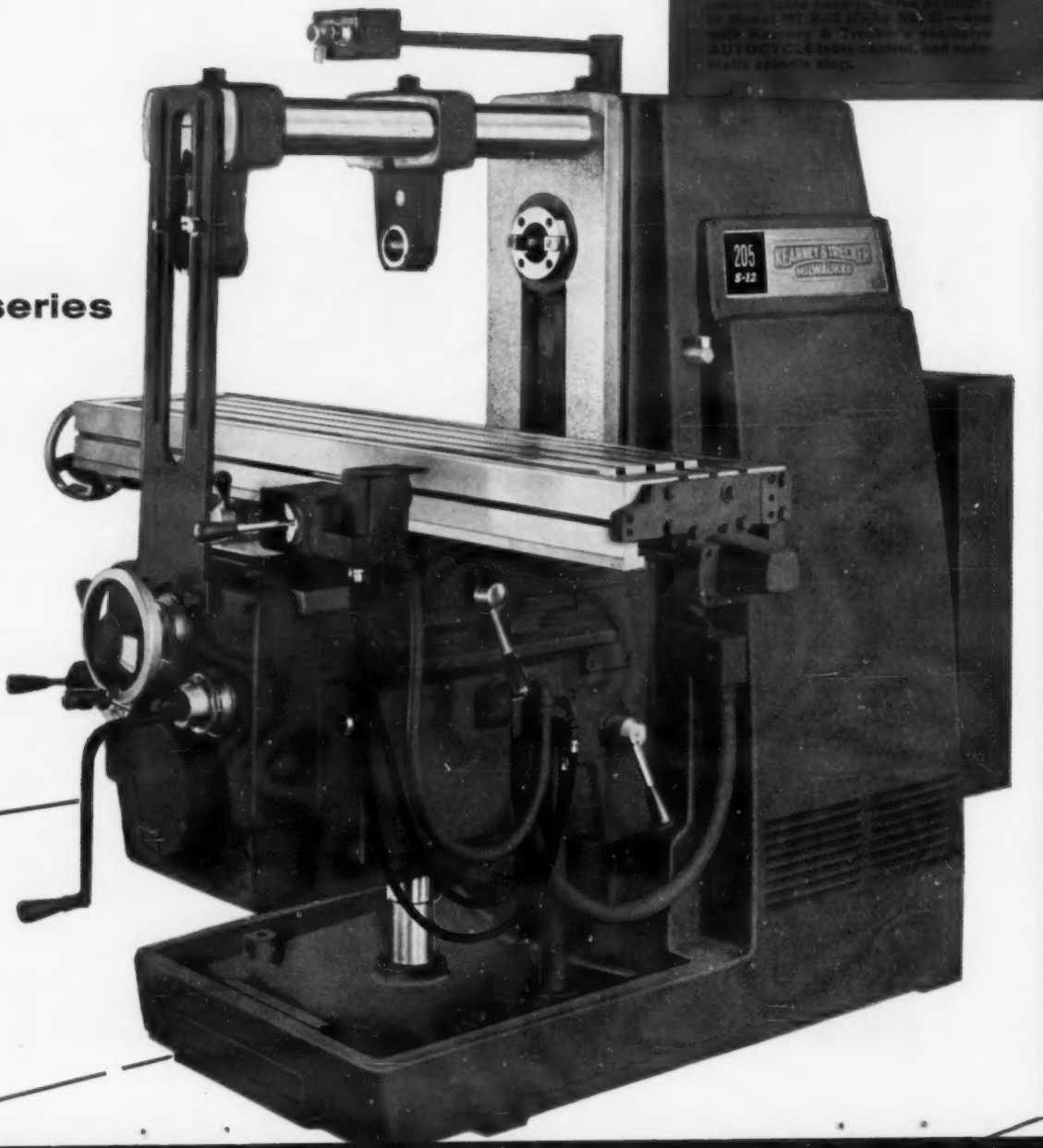
Here are but a few of the new "S-12 Series" features that can help you make more parts — faster.

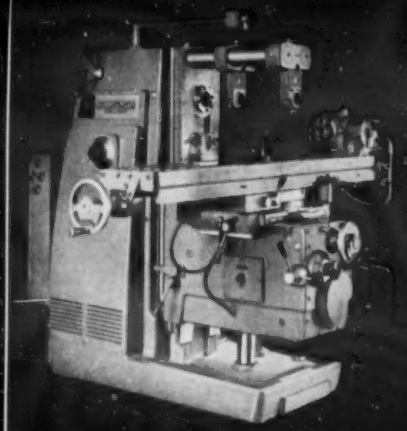


SIMPLIFIED TRIP DOGS . . .

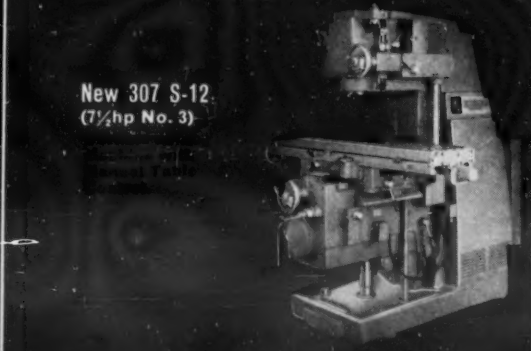
COMPARE K&T's exclusive **AUTOCYCLE Control** for production milling with knee type flexibility and versatility . . . more parts faster with less effort, because idle time is automatically converted to cutting time. Four types of trip dogs — Feed, Rapid, Reverse, and Stop — mounted in a single slot on the front of the table, control a basic reciprocal automatic cycle. Automatic cycles can be to left and/or right for either conventional or climb milling . . . permit utilization of full table travel.

New Model 205 S-12
(5hp No. 2)

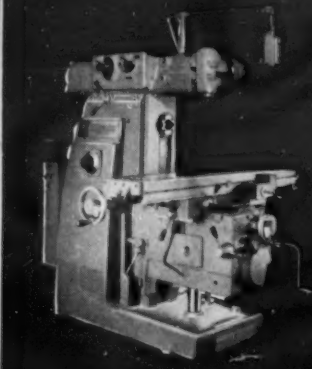




New 307 S-12
(7½hp No. 3)

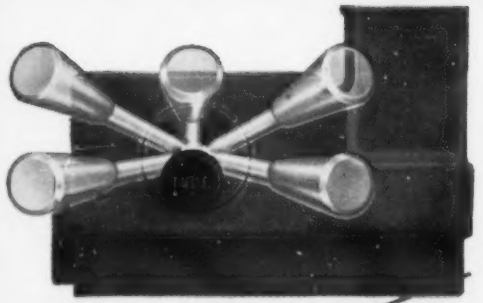


New 307 S-12
(7½hp No. 3)



New 307 S-12
(7½hp No. 3)

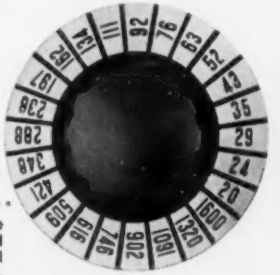
Available on
TOOL LEASE
Minimum Capital Investment
Your Choice of 3 Plans

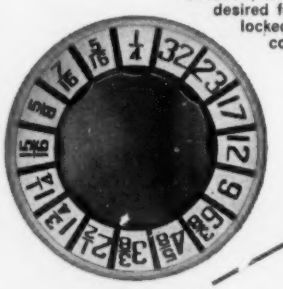


SINGLE LEVER CONTROL . . .
COMPARE this new concept in single-lever control, the **MONO-LEVER,** a Kearney & Trecker "First" in the industry. On all **AUTO-CYCLE "S-12's,"** this single, six-position lever controls table feed, rapid traverse, AND rapid traverse movements of saddle, knee, and vertical head . . . is used for both manual or **AUTOCYCLE** control with equal advantage.

POWER ASSIST FEED CHANGE . . .

COMPARE the speed and ease of the **S-12 Feed Rate Change . . .** a simple pull and turn with these large, easy-to-read Feed Range Dials through the shortest arc in either direction, and the **S-12** is set to the desired feed rate. Changes are locked in without over-ride or coasting — change gears are hydraulically shifted and held.





POWER ASSIST SPEED CHANGE . . .

COMPARE the ease of the **S-12 Speed Change.** Just a pull and turn of this large, easy-to-read dial through the shortest arc in either direction to select any of 24 speeds from 20 to 1600 RPM on the **205 S-12's.** 24 speeds, from 30 to 2400 RPM on the **307 S-12's.** Speed changes are locked in without over-ride or coasting. Shifting is smooth and quiet. Safety interlock prevents change being made during a cut.

AUTOMATIC BACKLASH ELIMINATOR . . .

COMPARE the **S-12's Self-adjusting Automatic Backlash Eliminator.** Makes climb milling just as easy as conventional milling. A mere twist of the wrist sets it for instant use in reciprocal milling cycles.

QUICK-SET DIALS . . .

COMPARE this **S-12** time-saver, **Rapid-Set Micrometer Dials.** Non-glare finish for easy reading . . . spring-loaded. Merely pull out and rotate to desired setting, and release for quick, positive-lock settings . . . graduated in .001" increments. Handwheels and handcranks do NOT spin during power feeds or rapid traverse.

This is but a brief look, a mere smattering of the outstanding features incorporated in these all-new *S-12 Series* machines. They're literally new from top to bottom, inside and out, for truly modern cost-saving, maintenance-saving, fast, accurate, profit-producing operation.

All we ask is that you Consider and Compare these all-new Kearney & Trecker S-12 Series Milling Machines. Discover for yourself that there are none newer . . . none finer . . . none better suited for increasing productivity.

To assist you, the facts for your *Consideration and Comparison* — Bulletin No. S-60, and RS-60 will be mailed promptly upon request.

Standard Machinery Division

KEARNEY & TRECKER CORP.
6800 W. NATIONAL AVE., MILWAUKEE 14, WIS.
(or phone GReenfield 6-8300... direct Distance Dialing Code No. 414)

KEARNEY & TRECKER
MILWAUKEE

Use Reader Service Card, CIRCLE 61

Sharp Clean Cuts EVERY TIME

Many thicknesses and sizes of metal are cut on this Steelweld Shear every day. Thanks to Steelweld's exclusive MICRO-SET knife adjustment, it is easy to set the knife clearance to the exact amount which will produce the best cut for every plate run through the machine.

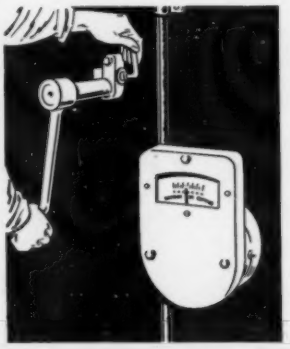
If desired, the knife clearance can be set for an average thickness and all plates cut without changing the clearance. This procedure is used with most shears because to change knife clearance on them is a tedious, difficult operation which usually puts a machine out of service for hours.

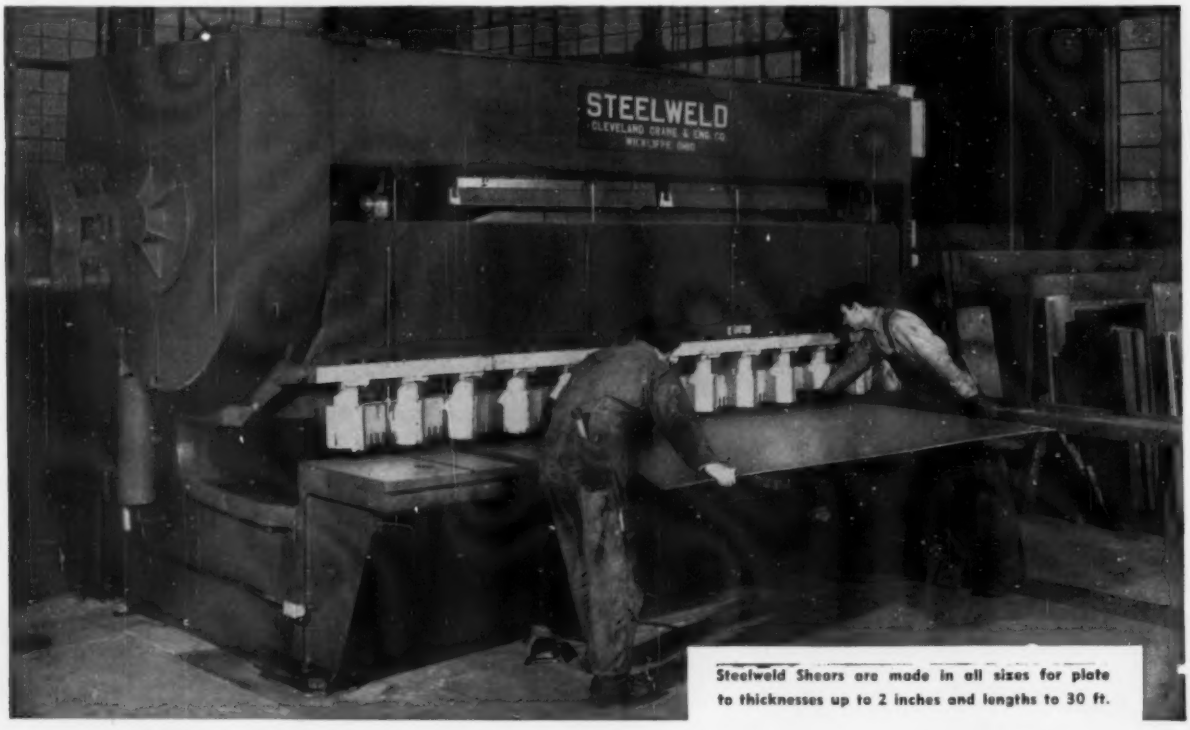
In contrast, knife adjustment on Steelwelds is made in a few seconds. It's simply a matter of turning a crank until an indicator points to the figure representing the thickness of plate being cut. No bolts to loosen; no parts to move. There is no need for using "average" knife settings.

The clutch and brake unit is another outstanding feature of Steelweld Shears. As it is air-operated, it is quick, snappy in action. Its low-inertia design assures cool operation, even after long continuous production runs, because energy to be dissipated is minimized and working pressure necessary on clutch and brake facings is greatly reduced.

The many features of Steelweld Shears make it worth your while to get all the facts.

Because of MICRO-SET Knife Adjustment





Steelweld Shears are made in all sizes for plate to thicknesses up to 2 inches and lengths to 30 ft.

GET THIS BOOK!

CATALOG No. 2011 gives construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.

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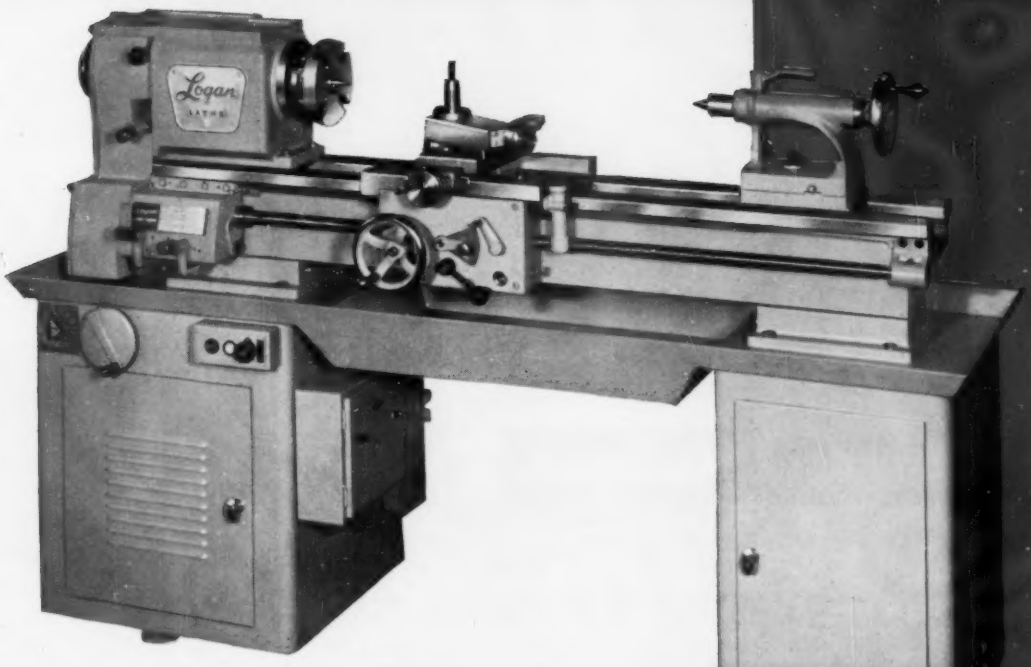
STEELWELD PIVOTED BLADE SHEARS

its specifications add up to high production capacity

Logan 14" Lathe



Logan No. 6565 14" Lathe

Logan designs greater reliability and accuracy, and longer life into its lathes by a generous combination of high-quality features. For instance—

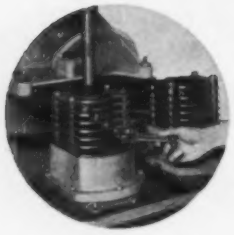
- An oversize spindle with 1⅝" bore turns on four super-precision ball bearings with built-in preload
- A variable-speed drive lets you change speed while work is turning—without shifting belts
- A warp-free lathe bed with high, strong walls braced by oversize ribs to withstand heaviest stresses; two V-ways and two flat ways are flame-hardened and precision-ground.

There are many more reasons why this and other Logan Lathes have a greater capacity. The specifications tell the story. Write for literature and complete information.

- Spindle speeds to 2000 rpm.
- 1½" Levermatic collet chuck capacity
- 14⅝" swing over bed
- 9" swing over saddle cross slide
- 40" between centers

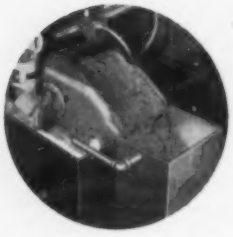
LOGAN ENGINEERING CO. Dept. U-261 4901 Lawrence Ave., Chicago 30, Ill.

QUALITY FOR YOUR PRODUCTS STARTS HERE



...WITH BARNESDRIL HONING MACHINES

Guarantee product quality through precision BarnesdriL Honing Machines. Greater ruggedness . . . a broader range of capacities . . . more compact design . . . easier maintenance — these are plus features inherent in every BarnesdriL machine to assure precision control at cost-cutting production rates. Our catalog 200 gives complete details. Write for your free copy!



...WITH BARNESDRIL FILTERS AND SEPARATORS

Control finish quality easily, more economically with BarnesdriL Filters, Separators, and Combination Filter-Separators. Designed to provide an abundant supply of clean, grit-free coolant, these automatic sludge removal units extend wheel life up to 50% . . . speed honing, gear-shaving and similar operations . . . cut coolant costs up to 300%. Send for catalogs 100-A and 300-D.

BARNESDRIL HONING MACHINES

Honing Machines/Production Units
Filtration Units/Drilling Machines

BARNES DRILL CO.

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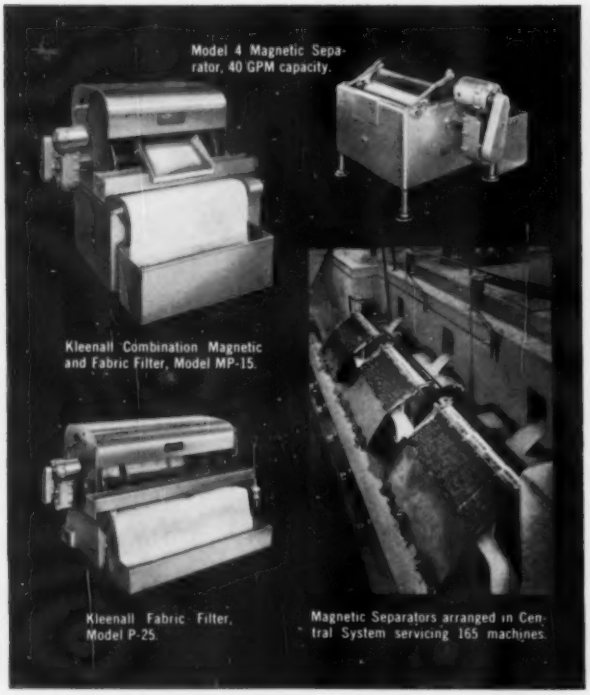
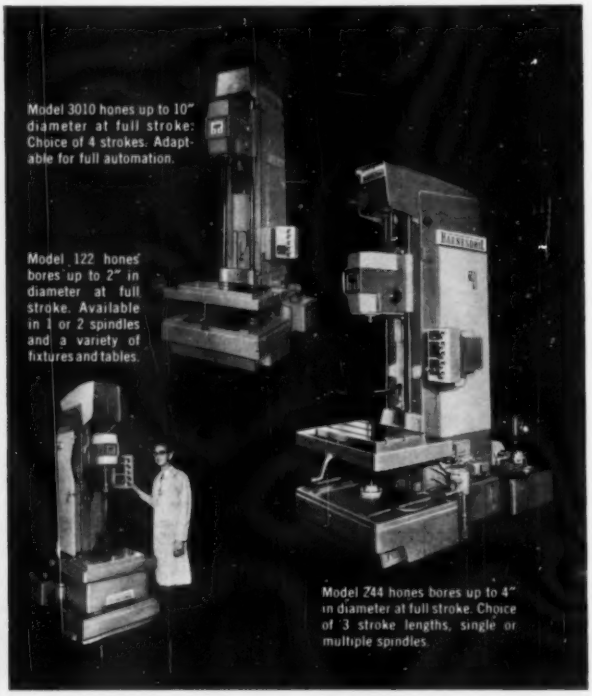
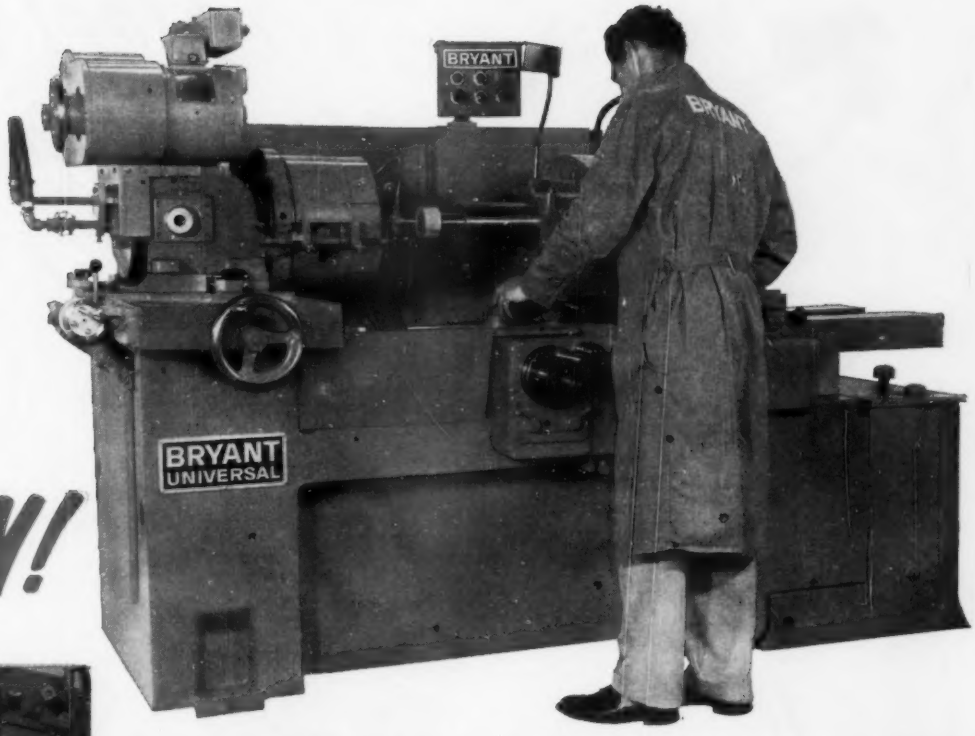
DETROIT OFFICE • 13121 PURITAN AVENUE

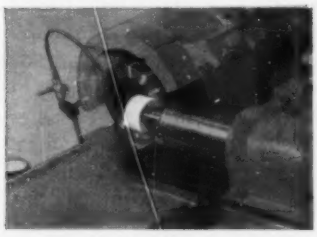

Model 4 Magnetic Separator, 40 GPM capacity.
Kleenall Combination Magnetic and Fabric Filter, Model MP-15.
Kleenall Fabric Filter, Model P-25.
Magnetic Separators arranged in Central System servicing 165 machines.


Model 3010 hones up to 10" diameter at full stroke: Choice of 4 strokes. Adaptable for full automation.
Model 122 hones bores up to 2" in diameter at full stroke. Available in 1 or 2 spindles and a variety of fixtures and tables.
Model Z44 hones bores up to 4" in diameter at full stroke. Choice of 3 stroke lengths, single or multiple spindles.

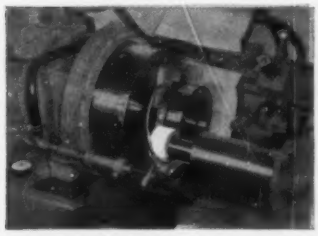


NEW!

For straight or tapered internal grinding!



For rotary ground flat surfaces!



For cylindrical or conically ground external diameters!

The BRYANT Universal Internal Grinder

A versatile machine that offers large machine capacity for internal, external and rotary face grinding.

The Bryant Universal performs a wide range of grinding operations and — what's more important — performs them quickly and economically.

The Bryant Universal is ideal for job shops or tool rooms where a single machine capable of handling a broad variety of workpart types and sizes is required. And it's accurate too: whether you are grinding to extremely close tolerances or doing routine production work, you'll find that the accuracy of size and finish obtained with the moderately priced Bryant Universal equals that of much higher priced machines.

Among the outstanding features of the Bryant Universal are:

COMPOUND CROSS SLIDE — Placement of the cross feed slide below the longitudinal traverse slide, results in sensitive, accurate slide control through reciprocation of a much lighter mass.

MULTIPLE WHEEL SPINDLE POSITIONS — Five longitudinal and two lateral positions for the wheel spindle combine with 15½″ of cross slide travel, eliminating the need for a large selection of grinding spindles.

SWIVELING WORKHEAD — 90° pivoting of the workhead facilitates the grinding of tapers or rotary face grinding.

LARGE WORK CAPACITY — The Bryant Universal swings 12″ dia. work within the chuck guard, up to 23″ with the guard removed.

REVERSIBLE VARIABLE SPEED WORK DRIVE — Variable speeds from 150 to 750 R.P.M. provide optimum grinding conditions for all jobs.

Contact your nearest Bryant or Ex-Cell-O sales representative, and let him show you how the Bryant Universal can make the production of varied workparts profitable for you.

BRYANT Chucking Grinder Co.

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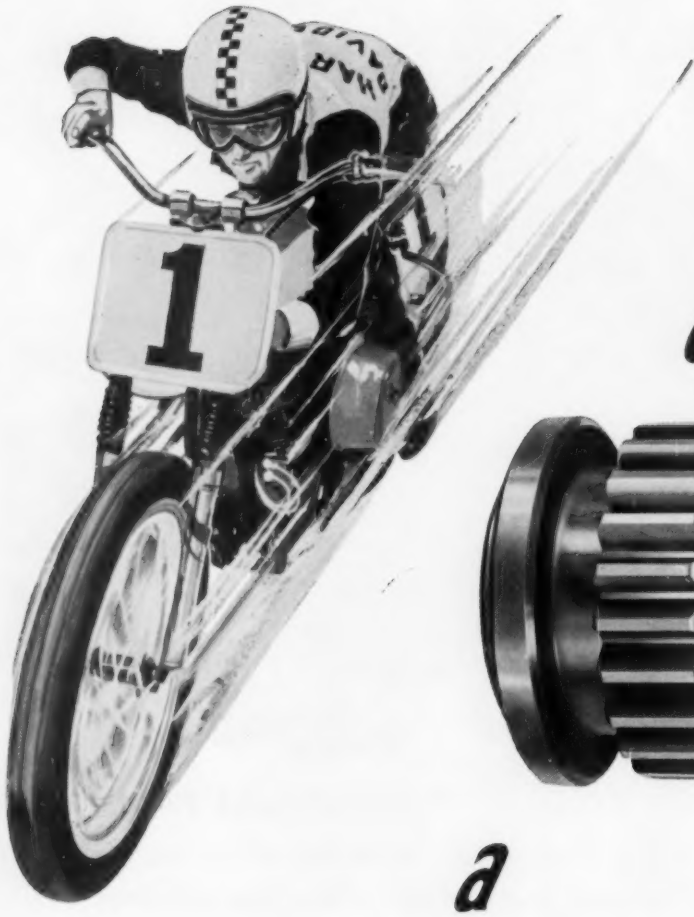
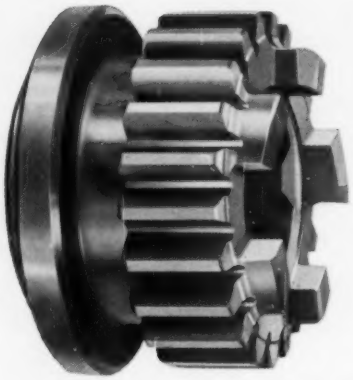
Internal Grinders • Special Machinery



Steel that gives cycles a stronger heart



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Despite all the money being used in this search for new knowledge, even more research is required to know how to most effectively utilize the new materials, the new machines and the new tools being developed. Research expenditures are expected to more than double in the next ten years. The total research effort means that tool and manufacturing technology will advance at an ever increasing pace.

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ASTME's responsibility is to inform you of the new knowledge pouring out of the research effort. The Society's responsibility is also to contribute directly to the search for knowledge. To this end, ASTME has a Research Fund Committee whose purpose is to sponsor research in areas of tool and manufacturing engineering that will be of particular interest to you.

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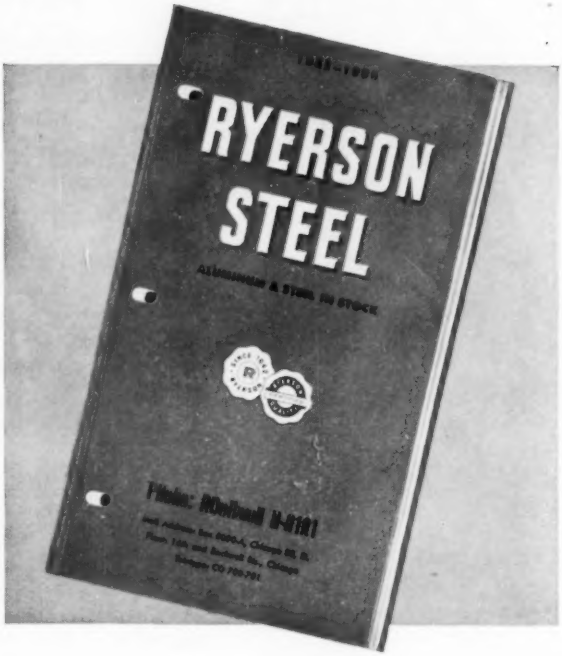

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Computer plans production lines

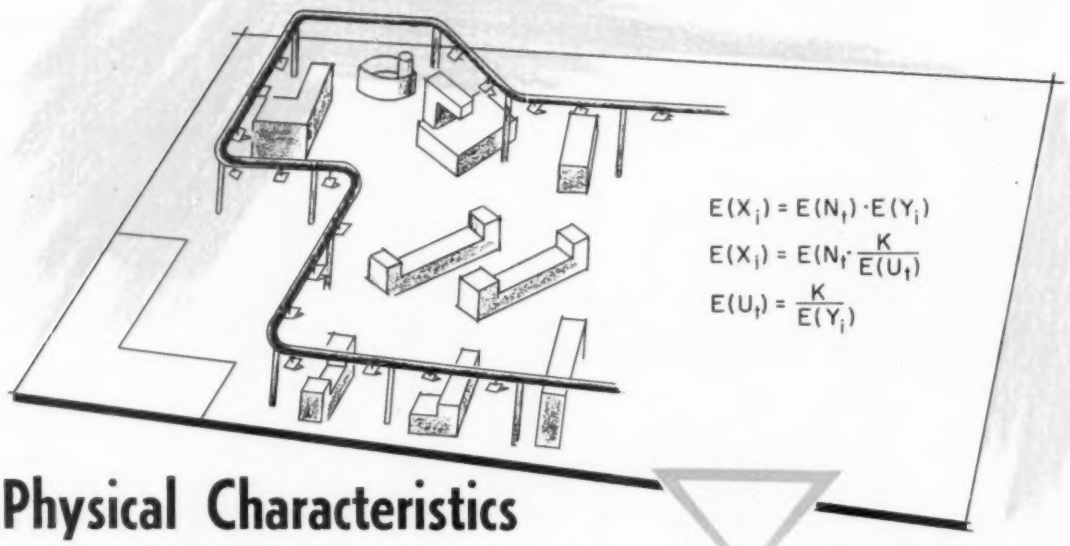
By J. E. McCombie
Factory Systems Design Engineer
Advanced Manufacturing Engineering Service
General Electric Company
Schenectady, New York

Computers, which have already demonstrated their ability to design products and to develop machining programs, are now being used to plan production lines. By simulating actual production runs, they make it possible to determine the efficiency of a production system before machines, tooling and other facilities are ordered.

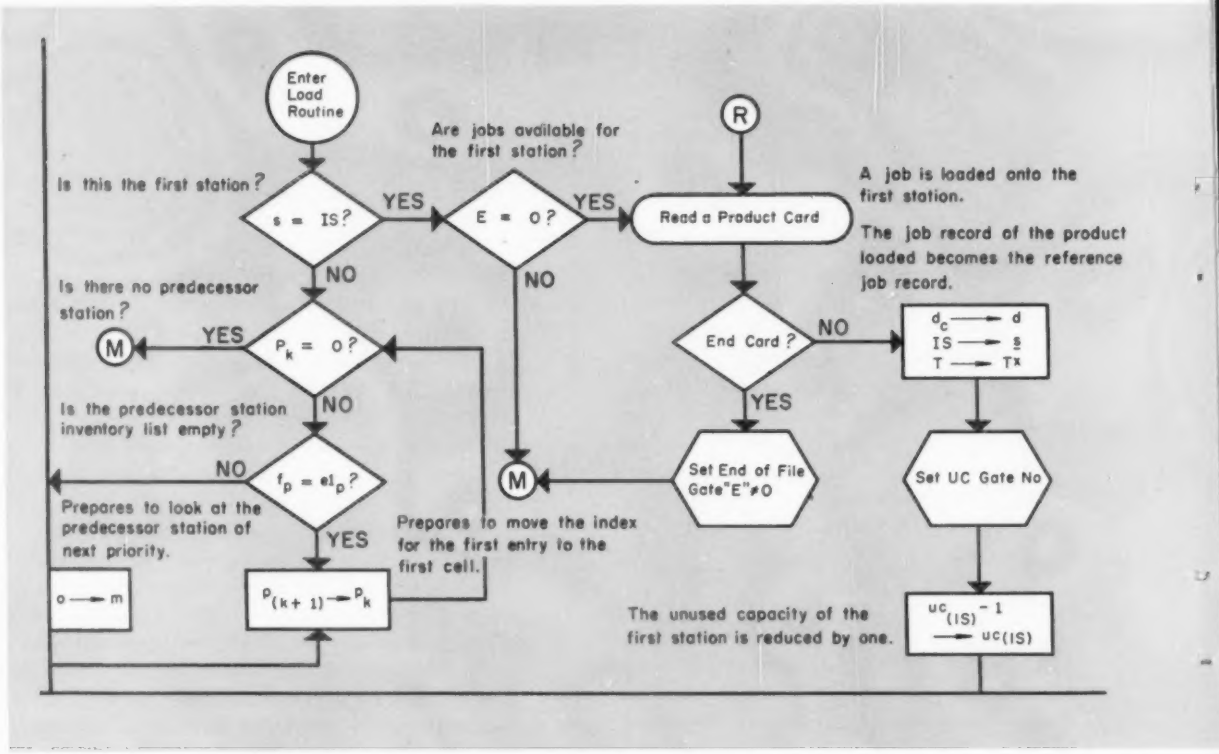
WITH THE ADVENT of automation and fast-changing markets, the response of manufacturing planning has taken on new importance. The installation of a new production line, the improvement of an existing line or altering lines to fit changes in product demand can be the cause of business success or business failure. Lead time is short and trying out alternative production systems under actual plant conditions is out of the question.

Unfortunately, despite the best efforts of skilled manufacturing engineers, it is not humanly possible to foresee all of the possible bugs or bottlenecks in a planned production. Nor it is possible—with paper and pencil or with actual scale models of machines and production equipment—to fully develop all of the possible methods of manufacturing a product and to evaluate them comprehensively. Planning time is short and mistakes are costly in time and money. For these reasons, manufacturing systems simulation has been developed.

Planning is being made more comprehensive and efficient, and mistakes avoided, through the new planning method—the use of computers to simulate planned production lines. This technique is applicable to all types of plants, from fully automated plants to job shops, and from large to small operations. The new concept in factory simulation adds a fourth dimension to the three-dimensional model —the dimension of time. With the added time dimension the factory model comes to life. In the computer model developed by General Electric's engineers, *Fig.* 1, parts are processed on machines, transported from machine to machine, line up at bottleneck machines, wait for labor and for each other just as they do in actual production. Using a computer, weeks or months of production experience can be gained in a few minutes and the results studied to determine optimum production systems. The consequences of changes in production scheduling policies, dispatch rules, manufacturing methods, alternate order loading proposals, plant layouts, machine specifications, product design changes, in-



Physical Characteristics


Enter Load Routine
Are jobs available for the first station?
R
Is this the first station?
s = IS?
YES
E = 0?
YES
Read a Product Card
A job is loaded onto the first station.
The job record of the product loaded becomes the reference job record.
NO
NO
Is there no predecessor station?
M
YES
P_k = 0?
End Card?
NO
$d_c \rightarrow d$
$IS \rightarrow \underline{s}$
$T \rightarrow Tx$
YES
Is the predecessor station inventory list empty?
NO
$f_p = el_p$?
Set End of File Gate"E"≠0
Set UC Gate No
Prepares to look at the predecessor station of next priority.
Prepares to move the index for the first entry to the first cell.
YES
$o \rightarrow m$
$P_{(k+1)} \rightarrow P_k$
The unused capacity of the first station is reduced by one.
$uc_{(IS)} - 1 \rightarrow uc(IS)$

Logical Model

Fig. 1. Like a plant layout, but with the added dimension of time, the characteristics of a factory are made into a model programmed in a computer to help plan production facilities.

ventory levels and material handling can be predicted with considerable accuracy without a significant investment in time and money.

Steps in Simulation: Effective utilization of a digital computer is essential to a practical procedure. Regardless of the type of computer or how powerful it might be, it can do only what it is told. In GE's experience, defining a factory problem and preparing data requires the talents of three different kinds of people working as a team—manufacturing engineers, modellers or systems analysts, and computer programmers. The manufacturing engineer or substantive expert usually recognizes initially that a specific manufacturing problem can use computer analysis. He is responsible for gathering and preparing data required—work flow diagrams, layouts, process charts, motion time studies, work sampling surveys and statistical probability studies. Working with the manufacturing engineer is a modeller or systems analyst who constructs mathematical representations of what actually happens when a certain product mix is scheduled through a factory area containing a specified number of critical resources such as men, machines, tools, inventory centers and so forth. The third member of the simulation team is the computer programmer who converts both the factory data and the mathematical model into language the computer can understand.

In focusing their skills on a particular production problem, these experts formulate a simulation procedure that includes five basic steps—data gathering, development of the mathematical model, programming, debugging of the computer run and making the final computer run. To these steps, interpretation and evaluation of the results—and production application—should be added.

Example: Computer simulation of plant operation has been successfully applied at General Electric's Hickory, N. C. plant. This plant produces pole-type distribution transformers. The product line consists of both standard and special units. The plant's manufacturing operation is essentially a "semiflow job shop" in which parts and assemblies, *Fig.* 2, are moved from area to area for successive groups of operations rather than being worked on in one area.

The "tank shop"—the area in which the cases for distribution transformers are fabricated—was selected as the area for study. The objective was to develop and pretest methods by which tank fabrication efficiency could be improved.

During the first phase—data gathering—three manufacturing engineers spent over 1200 hours collecting the data required. The data included basic tank specification, flow diagrams, charts showing setup times, process times and conveyor speeds, master schedules of customer requirements and several tank shop schedules for orders of varying lot size.

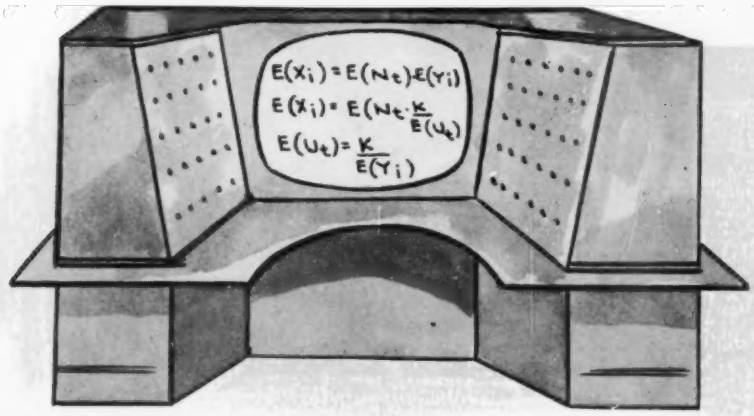
During the second phase—mathematical analysis—almost eight weeks was required to develop a suitable mathematical model of the tank shop.

The third phase—translating the mathematical model into a language that could be understood by the computer—took two month's work by two programmers.

In the fourth phase, debugging of the computer program, input cards containing (in punched form) such information as product and station characteristics (cycle times, setup times and routing data for each tank design), were fed into the computer. Then simulated tanks were literally run through the simulated production line or mathematical model of the plant in the computer. Records of time and a code identity for each tank were kept.

After the specified tank run, the results were printed out by the computer. The printed information included.

1. Station summary data, including the total time each work station was engaged in setup operations, proc-



Computer Model

essing operations and idle-time delays.

2. Station "queue" data, indicating, for specific times, the quantity of tanks at each processing or inventory station.
3. Tank production data, a record of the time of completion and identity of each tank produced.

This output data, *Fig.* 3, was analyzed by members of the simulator team to spot any failures in the computer program that would have to be corrected before the results of the simulated production run could be accepted as realistic.

After the debugging process, which took several weeks of careful study, final computer runs were made and more accurate output information was obtained.

In a fifth phase, application, the tank production line was rerun in the computer to test how various proposed changes in scheduling and dispatching would affect over-all plant efficiency.

Results: The simulated production runs showed that major savings could be realized by making some changes. It was evident, for example, that a proposed change in production scheduling would bring about an 86 percent reduction in tank manufacturing time with no significant increase in manufacturing costs. In-process inventory was reduced 42 percent and, most important, ultimate tank output capacity could be increased with less outlay for capital equipment than had been originally planned. Another important result was a better understanding of the effects of changes in tank model mix and volume on manufacturing activities.

Future Applications: Because of its ability to provide increased knowledge of the interactions within factory operations, simulation should have a great future in manufacturing planning. The results from the initial program at the Hickory plant have been so satisfactory that GE engineers plan to expand the use of this technique. Already, an improved simulation program, called GEST (General Electric Simulation Test) has been worked out. GEST is a signficant improvement over the Hickory program in several ways. It can be used for both job shop and flow shop work; it can handle a greater number of orders with more operations per order; it provides for dispatching jobs to machines using complex priority rules.

The new program, used with a large computer, rather than the medium-sized computer utilized for the tank line, enables manufacturing engineers to simulate many more factors affecting machine and plant loading, scheduling and facilities utilization. It has already been used for testing alternative rules for sequencing jobs through manufacturing facilities according to various orders, volumes and mixes. The program has also been used in the form coil shop to test a proposed facilities plan designed to raise labor productivity and increase machine utilization. The results of the simulation runs not only proved or disproved some of the plans, but they also gave the engineering staff some new ideas for improvements that will be tested on the simulator.

One of the most important applications of simulations will be to assist in solving the complex scheduling problems that arise daily under today's fast-

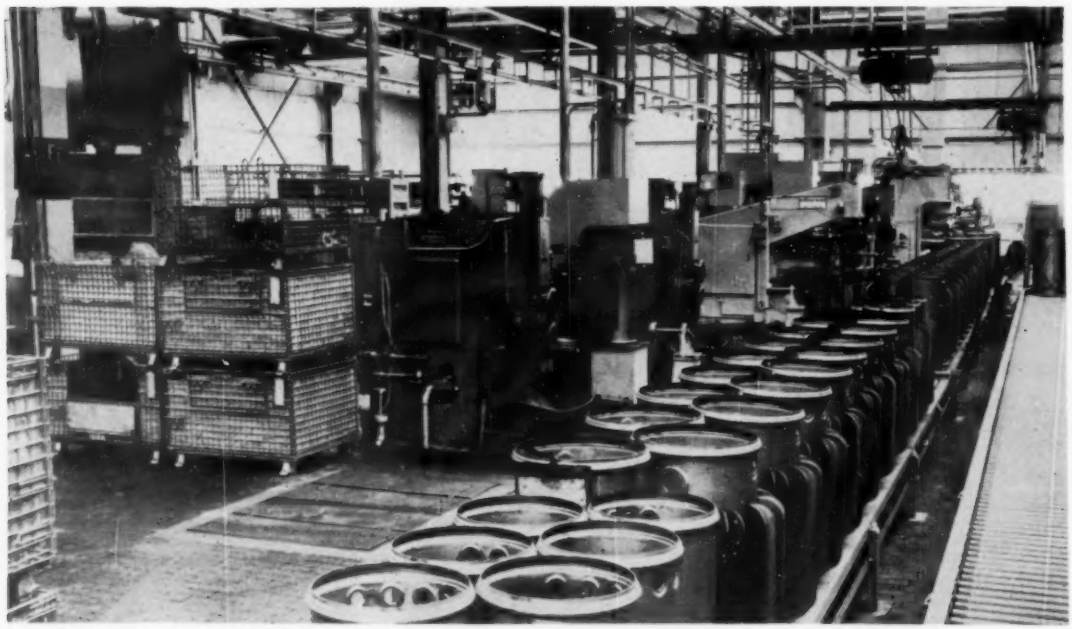


Fig. 2. Actual movement of each tank through processing stations was simulated in the computer.

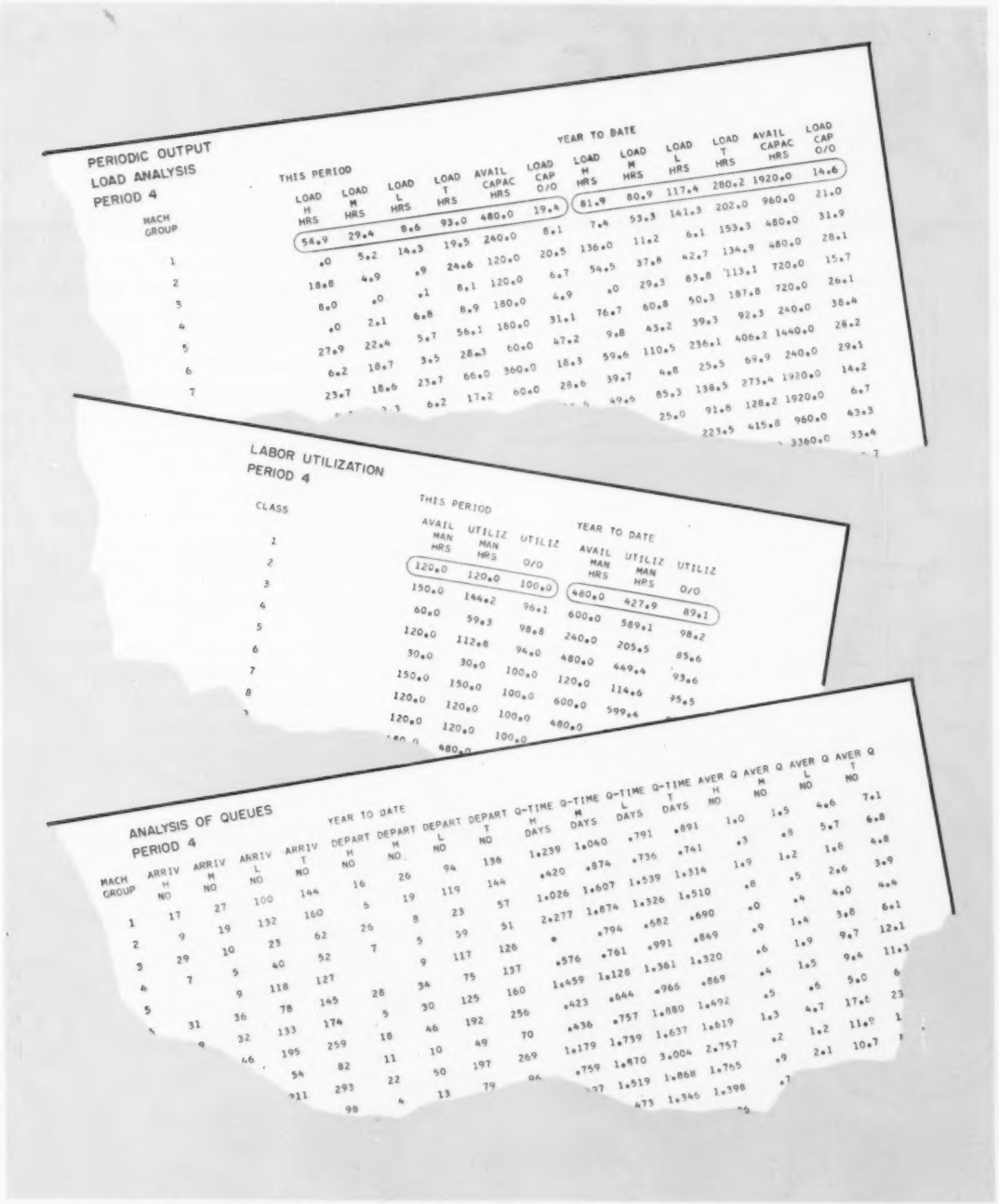


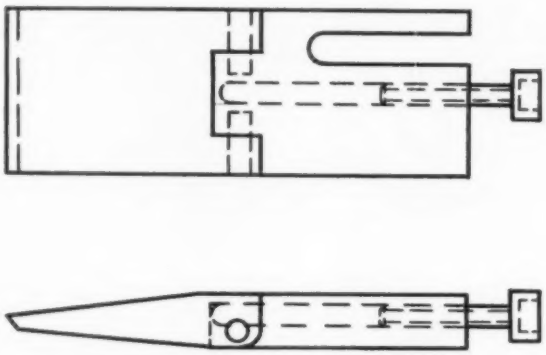
Fig. 3. Data on production runs simulated in the computer are produced in a matter of minutes.

changing business conditions. Use of simulation models for the actual control of manufacturing lines is already in the planning stages. A high-speed simulator can control a complex manufacturing system that has a multiplicity of interactions between open machine capacity, operation cycle time and the availability of materials, labor and storage space between operations. Sensing devices on the production line could feed pertinent data to the simulator, whose output would direct processing equipment, parts manipulators and transfer mechanisms to achieve the most efficient production possible.

These applications are some time in the future. Already, however, manufacturing engineers who have had experience with simulation feel that it is the most potent analytical and decision-making tool that has been developed for planning in 25 years.

Gadgets

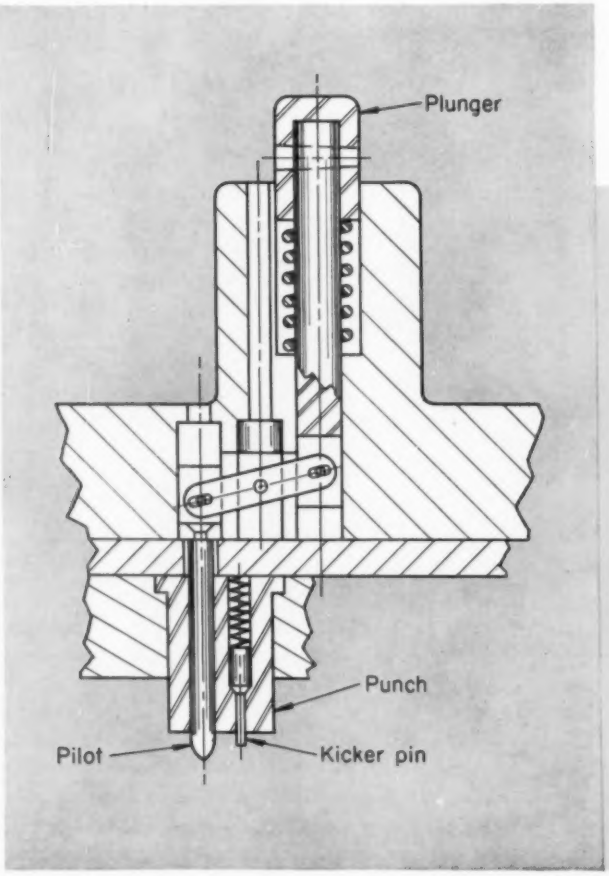
Ingenious Devices And Ideas



Chucking Device Holds Nonmagnetic Parts

Nonmagnetic parts can be held for surface grinding on magnetic chucks with the aid of two or more of these devices. Clamping is accomplished with a sharp-edged hold-down hinged to a cold-roll or tool-steel base. Tightening of the socket-head screw causes the hold-down to grip the workpiece and force it down against the chuck.

Henry E. Piltz
East Orange, N. J.



Spring Plunger Strips Pilot

This floating pilot eliminates slug-stripping problems resulting from the use of pilot-carrying punches. Stripping is accomplished by pilot withdrawal to a point above the cutting surface of the punch. After pilot withdrawal a conventional kicker-pin removes the slug from the punch.

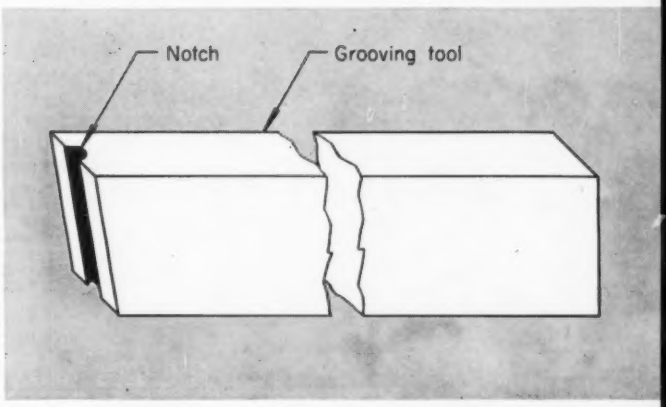
Movements of the pilot in either direction are effected by a simple linkage between the pilot and a spring-loaded plunger. At press up-stroke the pilot is withdrawn by plunger contact with a stationary knockout bar. When the die descends, spring pressure on the plunger returns the pilot to its operative position.

Donald A. Bruno
Racine, Wis.

Notched Grooving Tool Eliminates Chatter

Grooving tools used in lathe and shaper operations are highly susceptible to chatter. Normally the chatter can be minimized or eliminated by decreasing machine speed. Often, a more efficient solution to this problem is the use of a notch in the cutting-tool edge. In most cases this alteration can be made on a bench grinder. Equally effective on cutoff tools, this notch should be from $\frac{1}{16}$ to $\frac{3}{32}$ inch wide by approximately $\frac{1}{32}$ inch deep.

John Breen
Pittsburgh Chapter

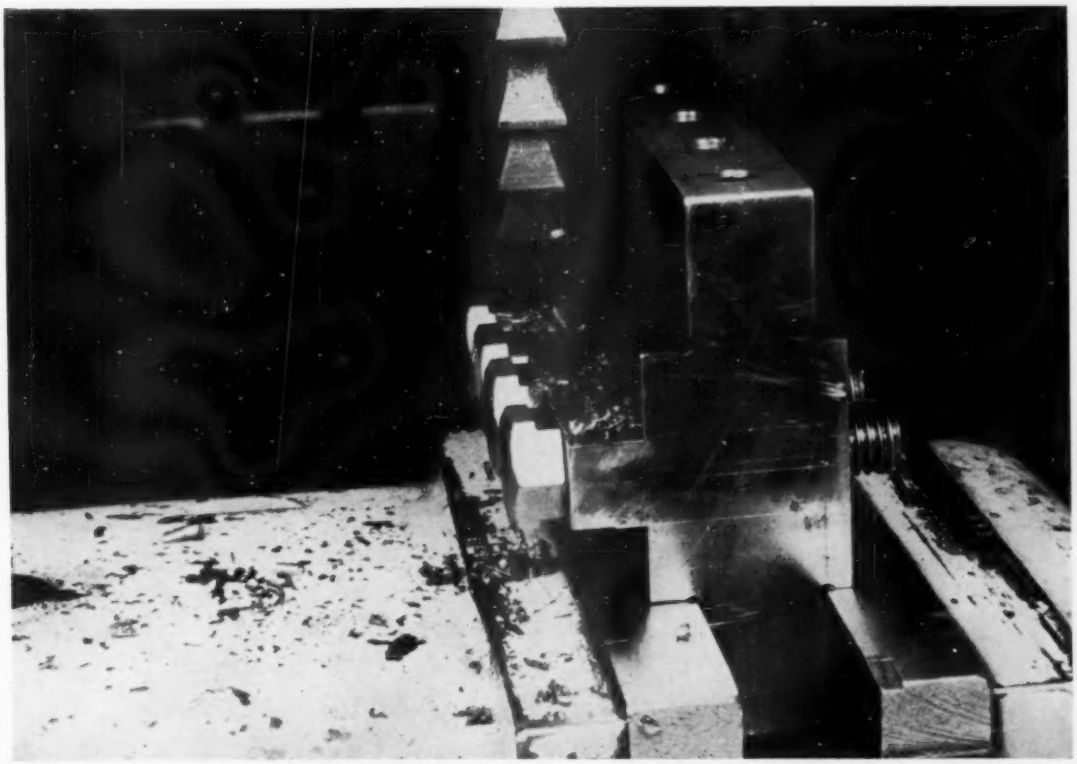


Vise Fixture Simplifies T-Bolt Milling

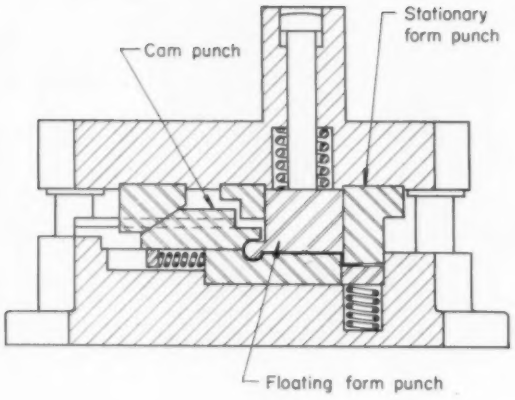
T-bolts, always in demand for machining operations, are inexpensively produced from standard hex-head bolts in this milling fixture. Only two machining cuts are necessary—one on each side of the fixture. Because the locating surfaces which position the fixture are symmetrical on either side of center, no correction in milling-cutter height is necessary when the fixture is reversed.

During machining, the bolts are held in position by setscrew pressure. To prevent galling, the pressure is exerted against soft plugs which bear against the shanks of the bolts.

H. J. Gerber
Stillwater, Okla.



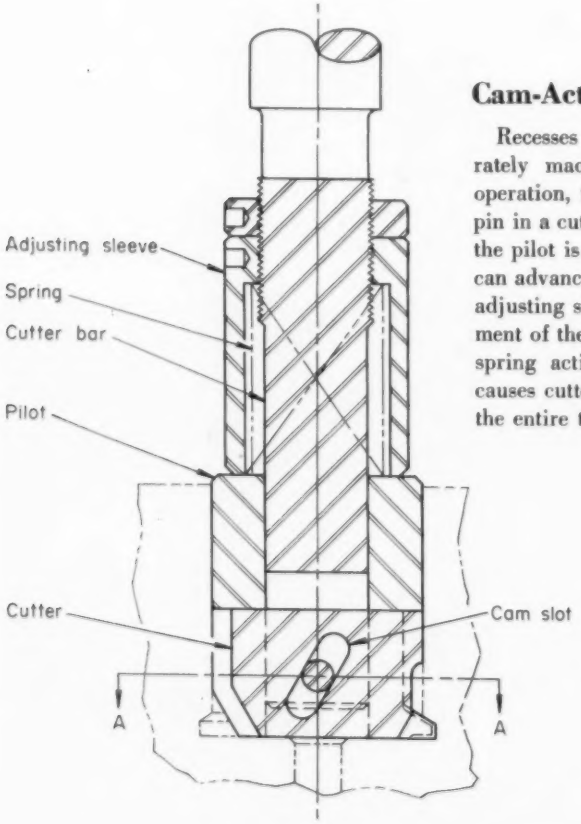
Gadgets



Die Curls and Bends

Two right-angle bends and a curl are accomplished by a single press stroke in this die. In operation, initial die contact is made by the floating form punch which creates 180 deg of curl. As die closure continues, a stationary form punch wipes the blank over the die block to effect the double bend. Simultaneously, the cam punch advances to complete the curl.

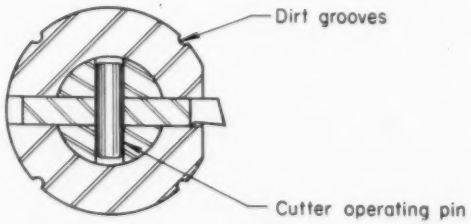
Hjalmar Dahl
Upsland Vasby, Sweden



Cam-Actuated Cutter For Recessing

Recesses at the bottom face of bored holes can be accurately machined with this recessing tool assembly. In operation, the cutter of this recessing tool is actuated by a pin in a cutter bar. The distance the cutter can emerge from the pilot is controlled by the vertical distance the cutter bar can advance. This distance, in turn, is limited by a threaded adjusting sleeve which can be preset for a prescribed movement of the boring bar. After the recess has been machined, spring action between the adjusting sleeve and the pilot causes cutter withdrawal into the pilot. This action enables the entire tool to be safely withdrawn from the bored hole.

M. W. Loftus
Chicago Chapter



Section A-A

Contributions for these pages describing short cuts for the tool engineer are welcome. Finished drawings are not necessary. Honorariums for accepted articles are sent upon publication.

HYDRAULIC CLAMPING

cuts over-all machining time

By W. M. Exely
Supervisor
Tool Design Section
U. S. Naval Ordnance Plant
Louisville, Ky.

Because it minimizes the delays associated with manual clamping methods, hydraulic clamping makes it possible to spend more machine time actually cutting metal. Over-all machine productivity is thus greatly improved.

ALTHOUGH HYDRAULIC CLAMPING has been in use for many years, until recently it has been restricted to applications where production volumes are high and the initial cost of the hydraulic equipment can be amortized over many pieces. Today, with the advent of compact, self-contained hydraulic units that are designed primarily for tooling purposes, it is feasible to use hydraulic clamping for short-run production. Thus the advantages of hydraulic clamping—quick action and uniform pressure—have been extended to the job shop.

The basic clamping system consists of a manually operated pump, hydraulic cylinders, and any necessary tubing, assemblies, brackets, adapters and accessories required for connecting and mounting the hydraulic components. A typical hydraulic clamping fixture, used on a boring mill, is shown in *Fig.*

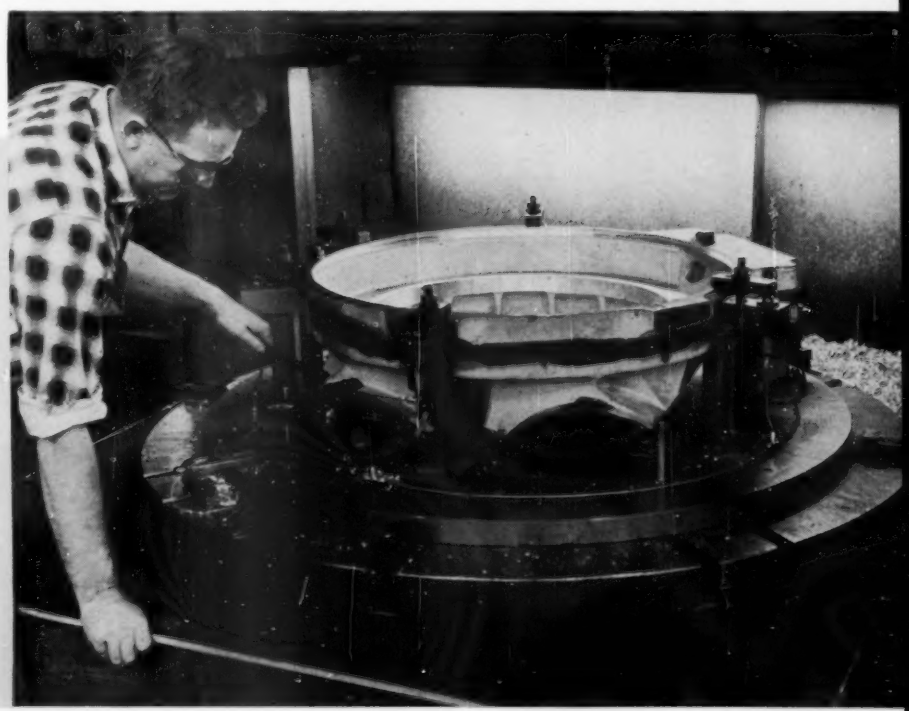


Fig. 1. Large aluminum casting is hydraulically clamped for machining. Hydraulic pressure of 2000 psi or more is achieved by manual pumping. Operator's left hand is on pump handle. The entire hydraulic clamping system is self-contained.

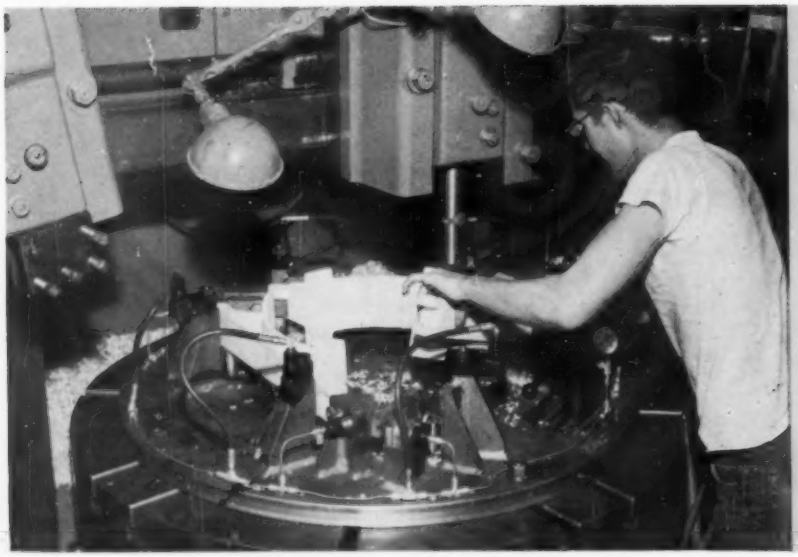


Fig. 2. Hydraulic fixture for machining three identical aluminum castings. Clamps are swung over the parts after the fixture is loaded.

1. The part is a complex and rather fragile aluminum casting.

After the part is placed in the fixture, the operator, using a lever-actuated pump, builds up the clamping pressure to 2000 psi for rough machining. The clamping pressure is released after rough machining and the part is reclamped, using 1050-1075-psi pressure, for finish machining. Higher clamping pressure would distort the outer flange of the part and lower clamping pressure would not hold the part adequately for machining. Achieving this controlled clamping pressure with mechanical clamps would be virtually impossible.

The time savings possible through self-contained hydraulic clamping are illustrated by the operation shown in *Fig.* 2. The parts in the fixture are aluminum castings. Three parts are machined simultaneously, each held by two clamps. Approximately one-eighth inch of stock is removed from the large radius of each part during machining. The parts are loaded against positive locators and end stops. After the parts are loaded in the fixture, the six clamps are rotated to the clamping position. The operator actuates the pump by means of the lever until 200-psi pressure is indicated on the gage. He then tightens a torque screw and pumps until a

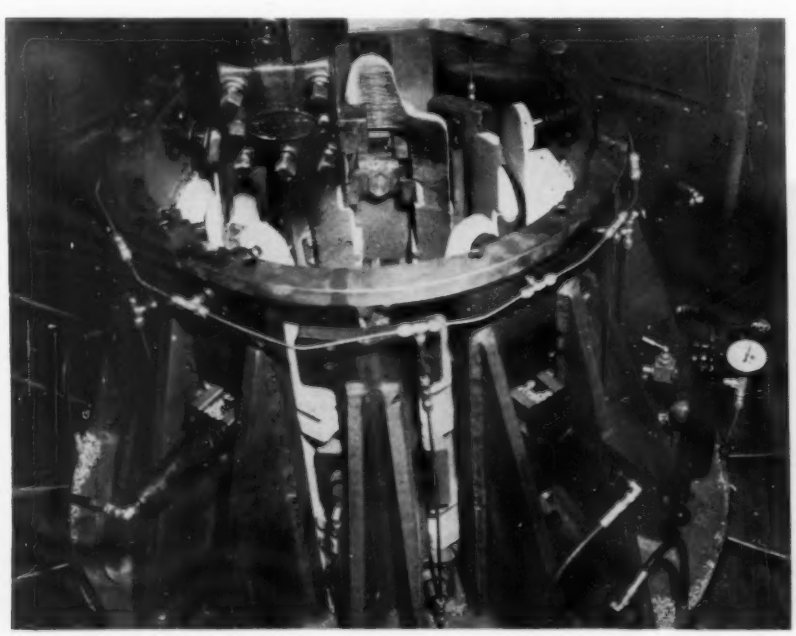


Fig. 3. Fixture for machining five aluminum castings simultaneously. Ten cylinders are used for clamping and twenty additional cylinders are used to support the workpiece for machining.

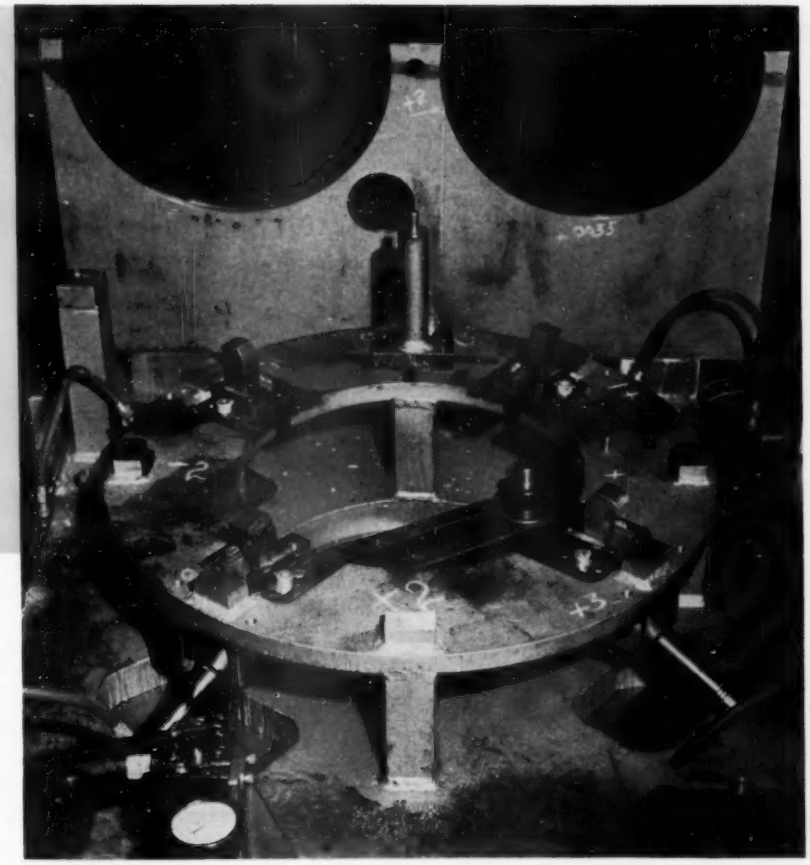


Fig. 4. A casting fits over the hydraulic clamps in this fixture. Mechanical clamps in this position would be shielded by the workpiece and a complicated mechanical clamp would be needed. Since the hydraulic clamps are remotely controlled, clamping is easy.

pressure of 2000 psi is reached. This clamps the parts firmly against the locators and stops. After machining, the operator opens a bleed-off valve to release the clamping pressure and backs off the torque screw in preparation for the next clamping cycle. Clamping and unclamping takes 35.9 seconds.

For a comparable fixture using mechanical clamps, the total clamping and unclamping time would be 3 minutes, 43.1 seconds. Mechanical clamping involves running down and tightening nuts by hand, tightening a torque screw and lock ring, getting a wrench and tightening nuts with a wrench, replacing the wrench and so on. The same procedure is followed in reverse when parts are unclamped after machining. Dollars-and-cents savings made possible by the use of hydraulic clamping on this job amount to about 15 cents per part for a total of over $600 savings during the course of the total production run.

Even greater savings have been realized by applying hydraulic clamping to the fixture shown in *Fig.* 3. The part is an aluminum casting approximately 8⅜ inches wide and 24 inches long. Some 3/16 inch of stock is removed from an 8.195-inch radius during machining. The fixture holds five parts and is completely hydraulic. Parts are butted against three positive locators and are supported by a block at the bottom of the fixture. Toe clamps are rotated into the position shown to hold the part snugly against the positive locators during machining. Ten cylinders are used for clamping and twenty hydraulic cylinders are used to steady the workpiece, preventing the part from bending as the result of machining forces. After loading the parts into the fixture, the operator pumps about 150-200-psi pressure into the system. Then he turns a needle valve to close out all the hydraulic cylinders except the ones attached to the toe clamps. Further pumping brings clamping pressure up to 2000 psi.

Total clamping time is 33.04 seconds. By contrast, 5 minutes, 19 seconds are required to clamp parts mechanically in an equivalent fixture. The operator's work with the hydraulic fixture includes closing a bleed-off valve, pumping 31 cycles to achieve low pressure, turning a needle valve 90 deg to cut off the support cylinders, pumping two cycles to achieve the 2000-psi clamping pressure, opening a bleed-off valve at the end of the machining cycle and turning the needle valve 90 deg to open up the lines to the positioning cylinders.

With a mechanical fixture, the following work would be required: running down and tightening

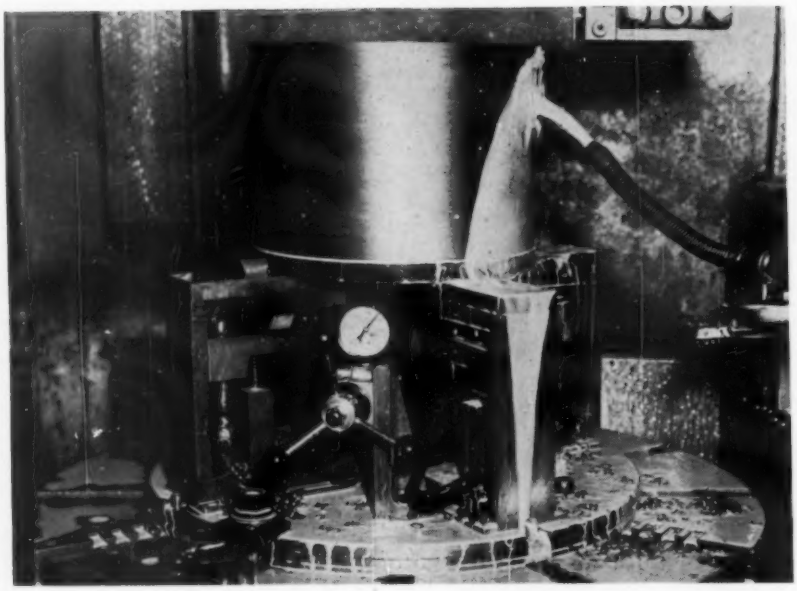


Fig. 5. Hydraulically actuated scissor clamps grip this cylindrical workpiece for machining. Walls of workpiece are relatively thin and conventional chucks would distort the part when exerting sufficient pressure to hold the workpiece securely.

10 nuts by hand, tightening 10 nuts with a wrench, tightening 20 torque screws, tightening 20 torque screw lock rings and so on. The same procedure is followed, in reverse, to unclamp the parts. Additional time may be required to position the boring mill table to facilitate tightening or loosening nuts and torque screws.

In addition to the time saved by hydraulic clamping, quality has been improved. Uniform steadying and clamping pressures assure greater machining accuracy than may be possible with mechanical clamping. The reduction in scrap also results in dollar savings.

Another advantage of hydraulic clamping is illustrated by the fixture shown in *Fig.* 4. This fixture is used to bore a large casting. The casting is supported on four locating blocks and fits over a locating pin. Because the clamping fingers are hidden when the casting is in place on the fixture, mechanical clamps would be difficult to use. Remotely controlled hydraulic clamps need not be accessible to the operator and clamping can be accomplished in a few seconds.

The fixture shown in *Fig.* 5 is unusual in that it employs a scissors clamp. A hardened cam plate is fastened to the clamping stanchion by four shoulder screws. These screws are smaller than the screw holes. This permits the cam plate to float about 0.060 inch, allowing for some degree of out-of-roundness in the part being clamped. During the clamping cycle, the hydraulic cylinder actuates the scissor fingers, which grip the wall of the workpiece and pull it down tightly against the cam plate. The fixture gives extremely tight clamping and, unlike a three-jaw chuck, will not squeeze the part into an egg shape.

These examples illustrate how self-contained hydraulic systems can be applied to a variety of fixtures. Hydraulic clamping is fast and, even more important, the controlled pressure that is possible through hydraulics can be an important factor in maintaining part quality.

"Real-Time" Computer Controls Scheduling

The first data-processing and communications system supplying facts and results virtually without time loss is the Univac 490 Real Time System. "Real time" describes computer operation that is simultaneous with an actual event.

One application for this system is in controlling and altering the trajectory of a missile in flight. Another application is for inventory and production control in manufacturing plants.

The system consists of a central computer and a number of transmitting stations. These can be located anywhere in the country and can communicate directly with the computer.

The system includes electronic real-time clocks that can be read by a control program that automatically indicates system activities. These can be used to set off an alarm when something happens that should be brought to the attention of management or they can signal the system itself to take specified action immediately.

high-production GUN DRILLING

By Carl Christen
Application Engineer
The Foote-Burt Co.
Cleveland, Ohio

Fig. 1. Diesel engine cylinder head being inspected after gun-drilling operations.

Gun drilling gives a combination of high speed and accuracy that suits it to high-production operations. Using several gun-drilling operations at GM's Detroit Diesel Div. as examples, the author shows how this process is put to work in modern manufacturing plants.

IN THE GUN-DRILLING PROCESS, deep (usually blind) holes are drilled at high speeds. Coolant is pumped at high pressures through the length of the tool to the cutting surface, flushing out chips, and keeping tool and workpiece temperatures down. In many cases feeds up to 60 inches per minutes are possible, with finishes as smooth as 4 microinches. This process has been successfully put to work at Detroit Diesel in the manufacture of cylinder heads, *Fig.* 1.

Gun drilling is employed to machine the cam-follower holes in the cylinder heads for two Diesel engine models, having cylinder displacements of 71 and 110 cu in., respectively. These holes are equivalent to the valve-lifter holes in a gasoline engine. There are three of them for each cylinder. They are 1.040 inch in diameter and 3 inches deep on the 71-cu-in. models, and 1.151 inch in diameter and 3⅜ inches deep on the 110-cu.in. models. The castings are alloyed gray cast iron, 163-207 Bhn. The holes are drilled from ¾-inch cored holes in the casting. Tolerances are +0.002, —0.000 inch.

Two one-way, six spindle automatic machines are used. One of these Foote-Burt machines operates on the 71-cu-in. production line, *Fig.* 2, the other on the 110-cu-in. line. Each of these machines gun drills and bores about 18 cylinder heads an hour.

The heads enter the machine from the right, leave from the left. As each head approaches the machine (on a roller conveyor), a pair of mechanical guide rails positions it for proper entry. Then a panel opens to admit the part, which is automatically clamped in position for the first drilling operation.

Drilling is accomplished in three passes, since there are three holes per cylinder. On the first pass, each of the machine spindles drills the first hole of each of the groups of three holes. After the first pass, the machine indexes the part so that the second cam-follower hole for each group of three is in drilling position. After the second pass, it indexes the part again and drills the third hole for each cylinder, then discharges the part.

Two-flute gun drills with solid carbide tips brazed to a body of SAE 4130 steel tubing are used. Cool-

ant is injected at the shank and fed through a center hole running the length of the drill to the tip. These drills produce about 1500 holes per sharpening.

Cylinder heads vary in length, depending on the number of cylinders of the engine. Furthermore, the 110-cu-in. heads are produced in two different styles, identical except for thickness. To make indexing accurate and uncomplicated regardless of the length or height of the cylinder head being machined, hydraulic wedge clamping fixtures are used to hold the piece during machining. The wedges are easily adjusted when changing over from one part design to another.

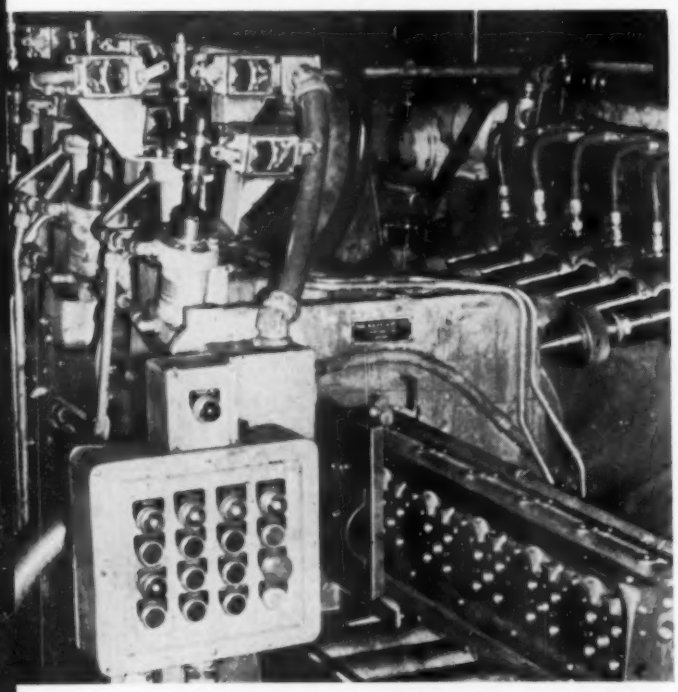


Fig. 2. One-way, six-spindle machine for gun-drilling holes in Diesel engine cylinder head. Here the head is entering the machine.

The two machines drill at different speeds, since the holes are slightly different in size. The larger machine, for the 110-cu-in. models, drills at 865 rpm (260 fpm). The smaller machine, for the 71-cu-in. models, turns at 960 rpm (268 fpm).

Both machines are capable of feeds up to 12 ipm. For Detroit Diesel's production requirements, however, the feed is 7½ ipm. This corresponds to a feed of approximately 0.008 ipr, providing smoothness and accuracy comparable to finish-reaming and keeping the chips small enough to be flushed out easily.

The coolant usually recommended for this type of gun-drilling operation is a high-grade cutting oil, pumped to the cutting surface at about 200 psi to wash the chips back out of the hole. Since the Detroit Diesel gun-drilling operations are on cored holes running all the way through the part, however, chip removal is not as much a problem as it would be with blind holes. Consequently, it is possible to use a water-soluble coolant at a pressure of about 65 psi. Both machines have filtration systems to remove particles larger than 5-10 microns from the coolant.

The gun-drilling machines replace the conventional drilling, reaming and boring equipment previously used. The surface finishes obtained are as good as those possible with the former method (100 to 300 microinches) and accuracy is excellent.

Lubricants Make Castings Smoother

Two difficulties in achieving a microsmooth surface finish when gravity die casting with aluminum alloys—filling the entire cavity without premature solidification of the alloy, and overcoming adhesion and built-up deposits between the die and casting—have been solved by the Akron Gravity Die Casting Co., Akron, Ohio, by using lubricants.

Either a colloidal graphite or a vermiculite lubricant, products of Acheson Colloids Co., Port Huron, Mich., are used. The graphite lubricant coats the cavities with a slick, protective film which helps ensure full metal flow throughout the die, serves as an effective parting agent and increases die life. It is able to withstand temperatures above 700 deg F without volatilizing or causing pockmarks. The vermiculite lubricant, for application to thin sections of the cavity, prevents the alloy from losing its heat through cavity walls and solidifying prematurely, and permits it to flow rapidly, regardless of thin sections or curves in the die. Both are mixed with water with various dilution ratios depending on the metal being cast, subsequent finishing operations and configurations of the cavity.

Akron Gravity reports that finishes as low as 40 to 60 microinches are obtained in their manufacture of missile and aircraft valves, high pressure fittings, aircraft accumulators, aircraft wheels, pump bodies, tire mold dies, small cylinder heads and outboard motor parts. This high degree of smoothness minimizes or eliminates the need for polishing and machining to meet customer specifications.

polishing CARBIDE DIES with diamond belts

Fig. 1. This die polishing machine uses a diamond belt. The die is mounted on a table that rotates during the polishing cycle. Operator is adjusting a small spotlight that directs light into the core of the die, simplifying accurate adjustment of belt angle.

By John Stangeby

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Time-consuming hand work in the refinishing of round-core carbide draw and extrusion dies is giving way to a machine operation that is far faster, more accurate and capable of producing much finer finishes than manual operation.

REFINISHING OF ROUND-CORE carbide draw and extrusion dies is exacting work. The original angles, face lengths and radii of the die must be faithfully reproduced. This refinishing is usually performed by skilled operators, who use steel lapping tools or wooden dowels. Today, hand operations are being replaced by machine operations, *Fig.* 1. This has been made possible by the development of die polishing machines that use diamond abrasive belts.

The results obtained are dramatic. In opening up a worn carbide die measuring 0.615 x ¾ inch to its next usable size, for example, removal of 0.006 inch of carbide stock from the bearing area requires only 15 seconds by machine. And regenerating all inner surfaces and angles of a worn die by machine consistently takes about one-tenth of the time required for refinishing by manual methods. Accuracy is better, as well, since hand tools wear with use and cannot deliver the reproducibility of dimension which is inherent in machine performance.

Apart from its speed and accuracy, perhaps the greatest single advantage of belt finishing is that it imposes grit lines in the direction of the draw, instead of circumferentially. This characteristic tends to extend die life considerably. The stress on drawing or extruding equipment is lessened, pickup is minimized and a finer finish is imparted to the workpiece. Experience has shown that belts of the grit range recommended for the process will produce finishes of approximately 1 to 2 microinches, rms, on carbide dies.

Die maintenance involves four major types of work: removal of wear rings, removal of pits and

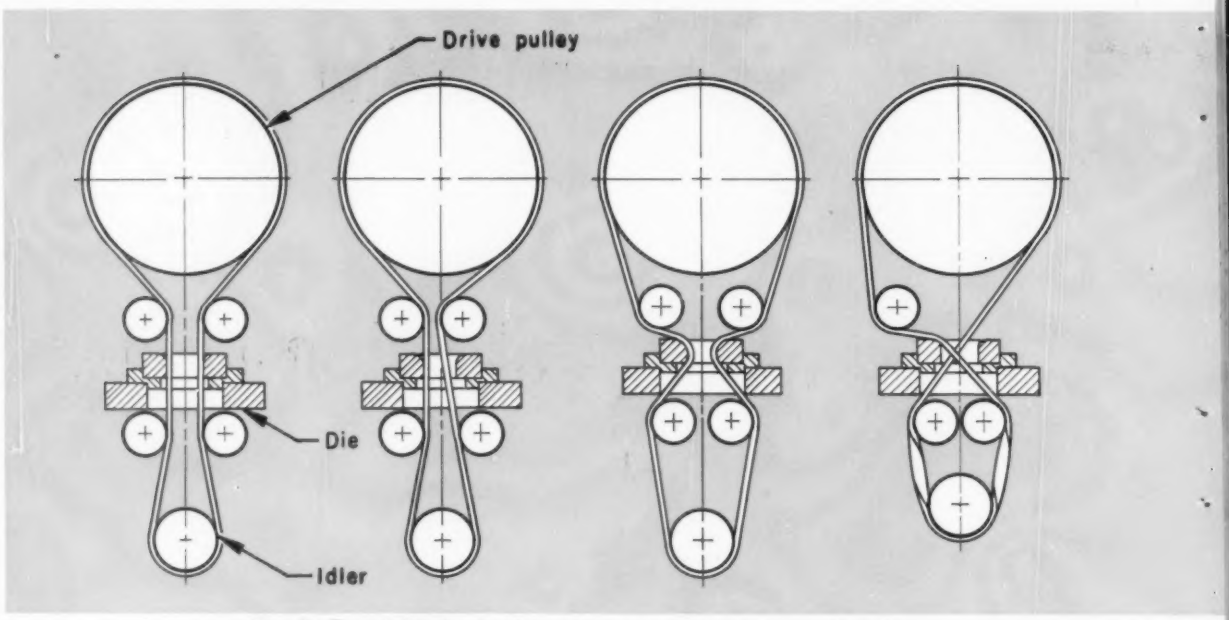


Fig. 2. To polish selected die sections, the angle of belt run through the die is altered by adjusting any or all of four small pulleys.

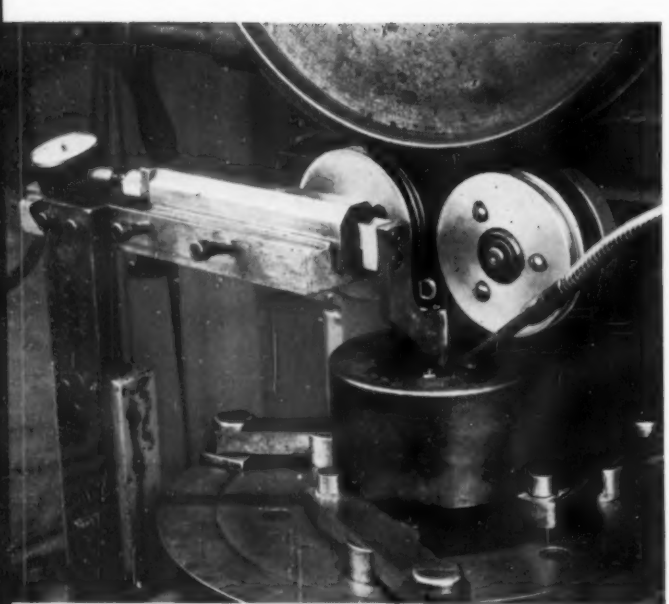


Fig. 3. Angle polishing fixture backs up the diamond belt along the full contact area. The fixture at left affords complete adjustability.

flaking that occur in the carbide, removal of material picked up by the face of the die from the work and restoration of original core geometry.

Development of wear rings is inevitable in most drawing operations. The severity of these annular depressions increases sharply with the number of pieces drawn, once the original wear ring has developed. Thus frequent inspection is necessary to detect the rings in their early stages. Any corrective grinding in the area of the wear rings should be followed, of course, by regenerating the correct angular and linear relationships of all die-core surfaces. This is a good application for diamond-belt polishing.

Pickup usually can be removed without trouble by a silicon-carbide coated abrasive belt. There is no need to use diamond belts for this purpose.

Core geometry needs revision when the die has been abused or when repeated refinishing has taken it out of tolerance limits so that it must be opened up to the next larger size. While diamond belts can be used for this purpose, they are not intended for heavy stock removal. Diamond chip boring is more economical. To open up a die with a bearing diameter of more than 1½ inches, boring is recommended. Diamond belt polishing should follow the boring operation. It is in performing this work—normally performed by hand lapping—that machine polishing gives the greatest returns.

The machine, made by Hartford Special Machinery Co., consists of a drive pulley and idler pulley; four adjustable pulleys whose setting regulates the angle of the belt as it passes through the core of the die, *Fig.* 2; a spring-loaded, carbide-faced steel angle-polishing fixture, which supports the belt at the grinding point or area, *Figs.* 3 and 4; and a two-speed, power-driven revolving table on which a universal die-holding chuck is mounted. The belt is tensioned by a manually operated lever. A micrometer indicator shows the rate of stock

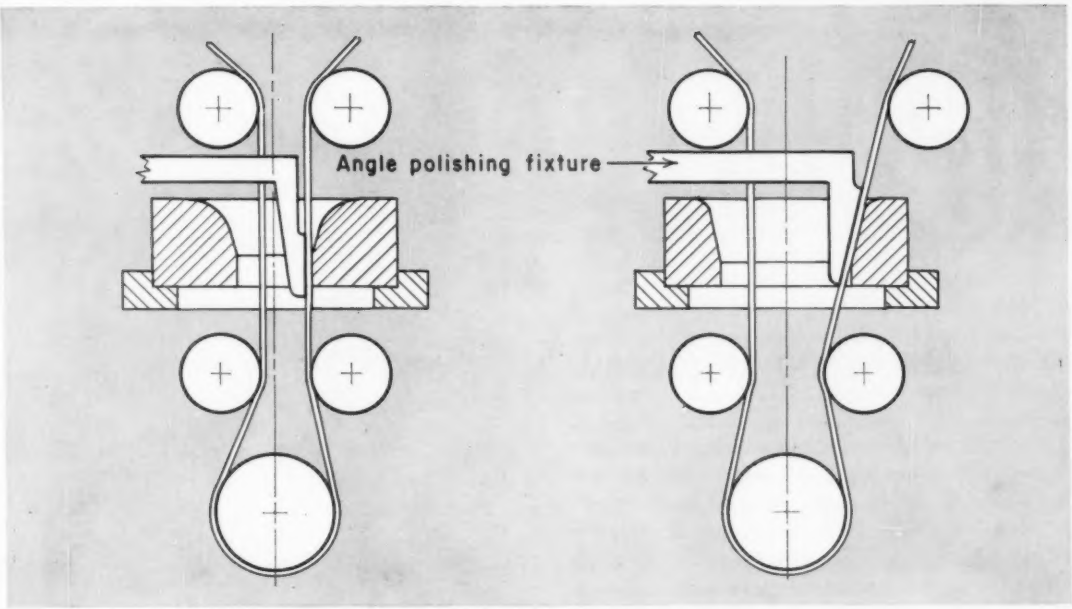


Fig. 4. Setups using angle polishing fixture. The anvil of the fixture is faced with carbide to resist wear and abrasion.

removal. A jet spray of water is used as a coolant.

The nylon backing of the belts is known to plastics engineers as an oriented monofilmament. The diamond particles are actually embedded and sealed into the nylon, whose natural elasticity provides a cushioning effect that prevents the diamonds from being torn out.

The belts themselves require slight but periodic maintenance. When they have accumulated a quantity of grinding swarf, visible on the belt and made perceptible by a reduction in the rate of cut, they should be submerged in solvent, then bathed in a solution of water and detergent.

Removing deep wear rings calls for a 100-grit belt; minor pits and flaking are removed by a 200-grit belt, which will also remove or blend grit lines from previous grinding operations; a 40-52 micron belt will restore dull surfaces to a smooth gloss, removing all grit lines. A 1-5 micron belt will produce the highest finish obtainable with belt polishing. Generally, ⅛-inch-wide belts are used for bores one inch or smaller in diameter; 3/16th-inch belts are used for larger cores.

Since belt polishing can, typically, reduce die refinishing time from 8 hours to ½-hour it is evident that it can effect considerable savings. Some users have found it practical to install a diamond-belt machine in the production area and use it to remove minor wear rings, pickup and pits during the few minutes when an operator is away from his machine on a coffee break. This eliminates the need of reworking slightly worn dies in the die crib and may make it possible to reduce die inventories.

It should not be assumed that an apprentice machinist will produce flawless results with diamond-belt polishing on his first attempt. Some skill is required, mainly in setting belt angles. However, the skilled operator with even brief experience will find that the machine is capable of greater geometric accuracy and finer finishes than he has ever encountered with manual die refinishing methods.

For this reason, diamond-belt polishing should be considered whenever fast and accurate refinishing of round-core carbide draw dies is necessary.

"Claims it relaxes him, gives his mind free and full imaginative rein and takes his mind off the awful pressure of you breathing down his neck constantly—"

designed for

PRODUCTION

Machining Hardened Steel and the Exotics

Industry's need for machines which can rough-cut or precision-machine hardened steel, superalloys and other exotics has been supplied by three new processes: electrical discharge, ultrasonic and electrolytic machining. Each has proved its ability to perform complex machining operations on the exotic materials used in Space Age manufacturing. As shown in the following pages, each of these processes can perform operations impossible to accomplish in any other manner. In some areas of manufacture these processes are competitive: in others, each represents the only possible solution to an otherwise impossible machining problem.

Electrical Discharge Machining: This process is preeminently suited to the machining of conductive materials, both hard and soft. Also called spark machining, EDM is occasionally confused with electrolytic machining—an entirely different process.

In operation EDM utilizes a low-voltage high-frequency stream of sparks emanating from an electrode to machine the workpiece. Both the workpiece and the electrode are immersed in a dielectric solution (usually a hydrocarbon oil) and a current is passed between them. As the electrode approaches the workpiece, the intervening dielectric ionizes and an electronic avalanche—a series of sparks—is initiated.

A spark contacting the workpiece vaporizes the point it strikes, leaving a pit mark. Although each pit mark is relatively small, the high frequency of spark discharge (in the order of 100,000 cps) makes EDM a highly efficient method of metal removal. Its most popular use is in tool and die applications where it is practical for all types and classes of work.

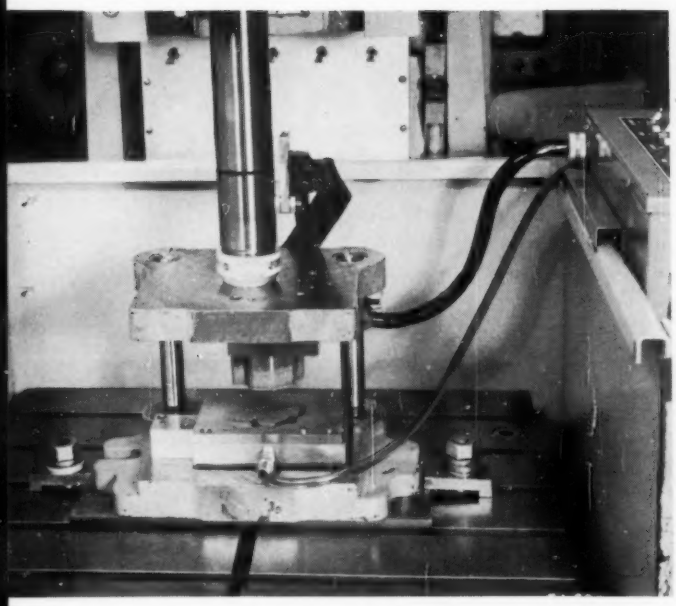
A variable which must be considered in EDM is electrode erosion. As electrodes perform their machining function they tend to lose their shape and size characteristics. Thus, in cavity work—forging dies for example—a series of electrodes for roughing and finishing operations is required. Because machining by sparks is essentially a melting operation, the materials best machined by this process are those with characteristics of low-melting temperature and high electrical resistance.

Ultrasonic Machining: This process utilizes vibration as a method of machining. The tool, vibrating in an amplitude of 0.001 to 0.005 inch at 20,000 cps, literally "bombards" the work area with particles of an abrasive slurry. In some respects, this action is comparable to sand blasting or concrete breaking by pneumatic hammers. However, as in EDM and electrolytic machining, no contact between tool and workpiece takes place.

Tool vibration in ultrasonic machining is induced by electrical current passing through a magnetostrictive transducer. The current supplied alternates at 20,000 cps. The resultant magnetic field imposes dimensional changes in the magnetostrictive device, thus establishing a pattern of vibration. Because ultrasonic machining does not require passage of electrical current through the workpiece, it is often the only practical method by which nonconductive material can be machined. Currently, this method is used most extensively in the electronic industry, but it is finding many applications in cavity work in the tool and die industry. It is, however, an impractical machining method when applied to materials softer than 56 R_C. Generally, the harder the material, the easier it is to machine by ultrasonics.

Electrolytic Machining: Often confused with EDM, electrolytic machining is essentially a deplating process in which material is removed from the workpiece by electrolysis. Its application is based on the fact that direct current, passing through an electrolytic solution, will dissolve a positively charged surface. The electrolyte, forced into the "machining" area under high pressure, flushes the decomposed metal from the work area. In some electrolytic grinding applications an abrasive wheel is used to assist in the removal of decomposed metal. No erosion of the tool (cathode) occurs in electrolytic machining.

With EDM, Machining is Fast



Increasing use of electrical discharge machining as a diemaking tool is due to its machining speed, accuracy and ease of operation. In this illustration a Cincinnati Electrojet is used to finish-machine a blanking die and its stripper in one pass. The punch—designed with additional length to compensate for the effect of electrode erosion—is machined by conventional diemaking techniques. It serves the dual purpose of the electrode for machining and the punch in die operation. Cutting contours are rough sawed in the die block and stripper to within 1/32 inch of finish size after which the die block is hardened and surface-ground. These components are then mounted on the lower die shoe with the sawed openings directly below the punch.

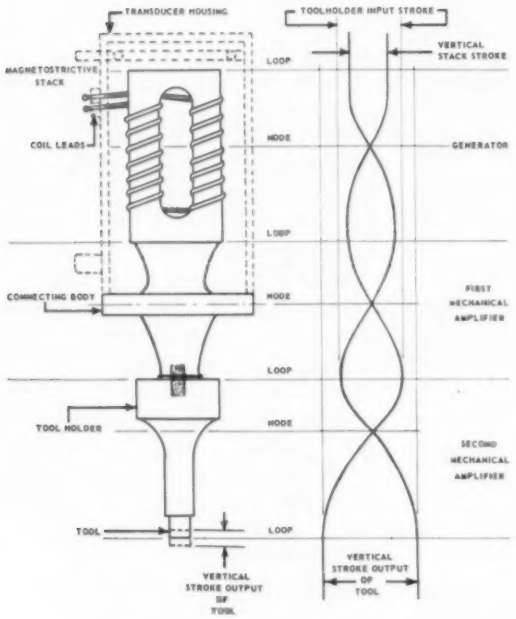
During machining an ample flow of dielectric solution is provided by the hose running to the die block. After machining has been completed only one job remains—the removal of the eroded area of the punch. This can be easily accomplished by conventional grinding.

. . . and Design is Simplified

An additional benefit of EDM is increased simplicity of design. In this die for example, the sectionalizing usually required for complex cutting contours is eliminated. Only two blocks are required. Because sectionalizing is eliminated, cutting sections need not be keyed or pocketed in the die shoe.

Machined on an Elox electrical discharge machine, this die shows the effects of electrode erosion on the punches. The extent to which punches will erode depends on the material they are machining, the type of power supply unit used and the amount of metal machined. In all cases electrode erosion can be accurately predetermined so that punches of sufficient length can be designed.

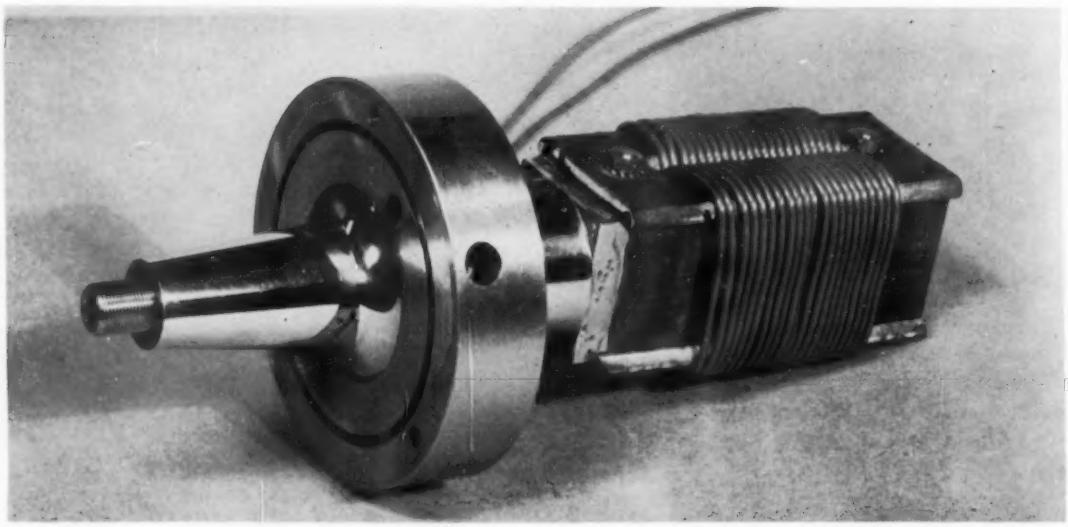
Sound Becomes Movement in Ultrasonic Machining



Magnetostriction—the principle that a body will change dimensionally when placed in a magnetic field—is the basis of ultrasonic machining. Because this dimensional change takes place instantly, oscillating magnetism can be used to induce a vibratory motion in parts within its field.

This diagram illustrates the manner in which vibration is amplified to produce a vertical stroke output of from 0.001 to 0.005 inch. Alternating current passing through the coil around the upper element creates a magnetic field causing the transducer to vibrate at frequencies equal to the frequency of the current. This vibration is transmitted through two mechanical amplifiers to produce the required tool movement.

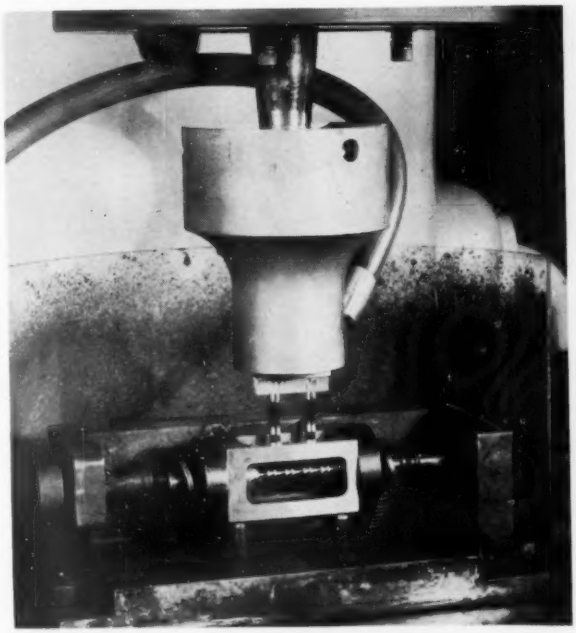
Movement is Effected by the Transducer



Adaptation of the maching tool to the toolholder can be accomplished by brazing or by mechanical fastening devices. The toolholder is fastened to the transducer by a screw thread. Together, these elements create the vibratory pattern necessary for machining by ultrasonics.

Multiple Tooling Speeds the Machining Process

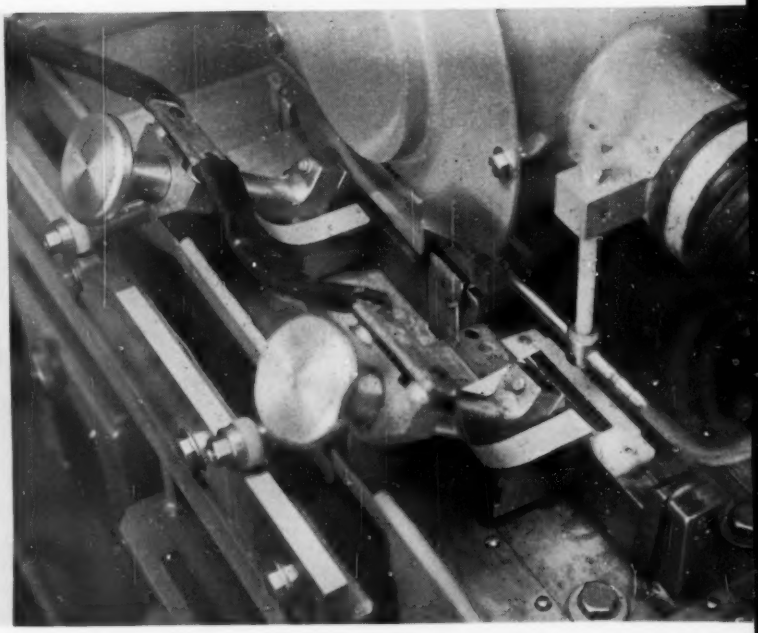
One of the fringe benefits of ultrasonic machining is multiple tooling. In this setup two identical tools are used to machine slots in a cylindrical component. Held between centers in a special fixture the workpiece is indexed as it would be in conventional machining. Tools in this machine, a product of Sheffield Corp., are relatively simple to design and fabricate. For example, no relief angles are required nor are there any problems of tool geometry. Design can be varied, however, to produce blind holes with tapered walls or configuration at the bottom surface. By use of adequate fixturing spirals or threads can be machined ultrasonically.



Electrolytic Grinder Finishes Turbine Blades

Trailing edges of stainless steel turbine blades are ground to dimensions as thin as 0.005 inch in this Cincinnati rise and fall electrolytic grinder. Similar to conventional grinders in appearance and workpiece fixturing, this machine "grinds" by deplating the workpiece. As in conventional grinders, an abrasive wheel is used but its basic purpose is to serve as a cathode.

During grinding the current dissolves the surface of the workpiece and the abrasive removes the decomposed metal. The abrasive itself is a nonconductor, its secondary purpose being the establishment of a working gap between the conductive bond of the wheel and the workpiece.

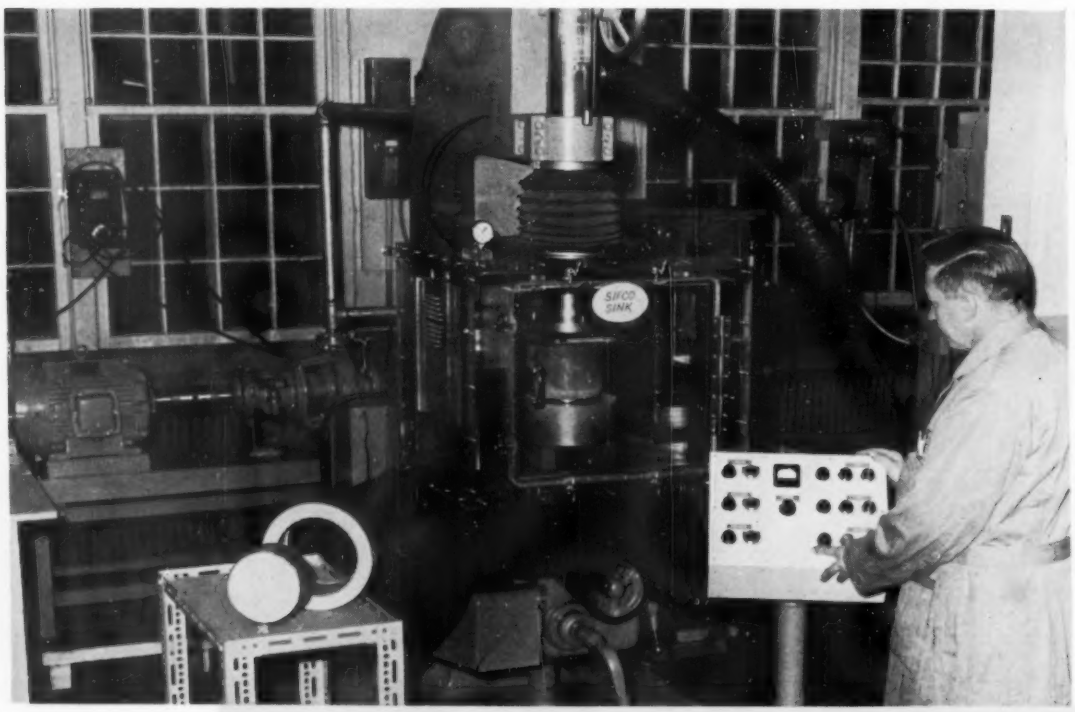


Sawing, Trepanning and Precision Machining Are Performed Electrolytically

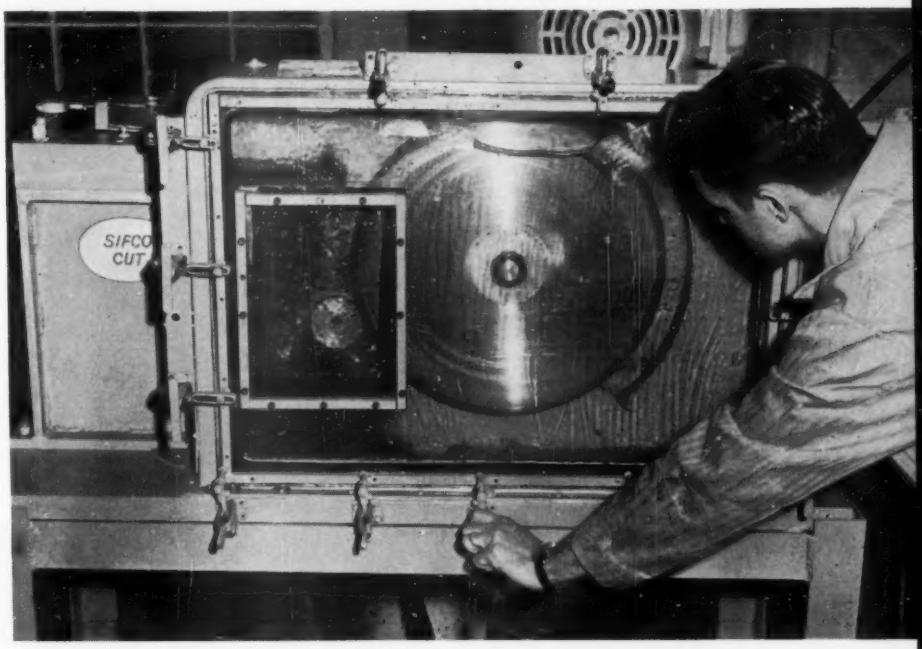
Three different types of machining—trepanning, cutoff sawing and contour forming—are accomplished in the Sifco Process, a relative newcomer to the field of electrolytic machining. In the trepanning operation an electrode is set up to cut a slug from a solid block of tungsten. During machining, the workpiece and electrode are subjected to high-pressure spray of electrolyte. The cathode—advancing at a predetermined rate—machines a circular groove in the workpiece by electrolysis. No erosion of the cathode occurs.

The Sifco cutoff machine illustrated is performing an operation comparable to sawing or abrasive grinding. However, the wheel is not abrasive and removal of decomposed material is accomplished by pressure of the electrolyte.

An example of the precision inherent in this process is illustrated in the electrolytic machining of turbine blades. The Sifco Shape—built for this purpose by The Steel Improvement and Forge Co. of Cleveland—utilizes two stainless steel cathodes to machine both sides of the blades simultaneously. Setup is effected by simple fixturing of the workpiece between the cathodes. Upon initiation of the machine cycle, rapidly circulating electrolyte enters the plastic enclosure and the cathodic tools begin a slow advance to a predetermined stop. Upon their arrival at the stop, machining is complete.

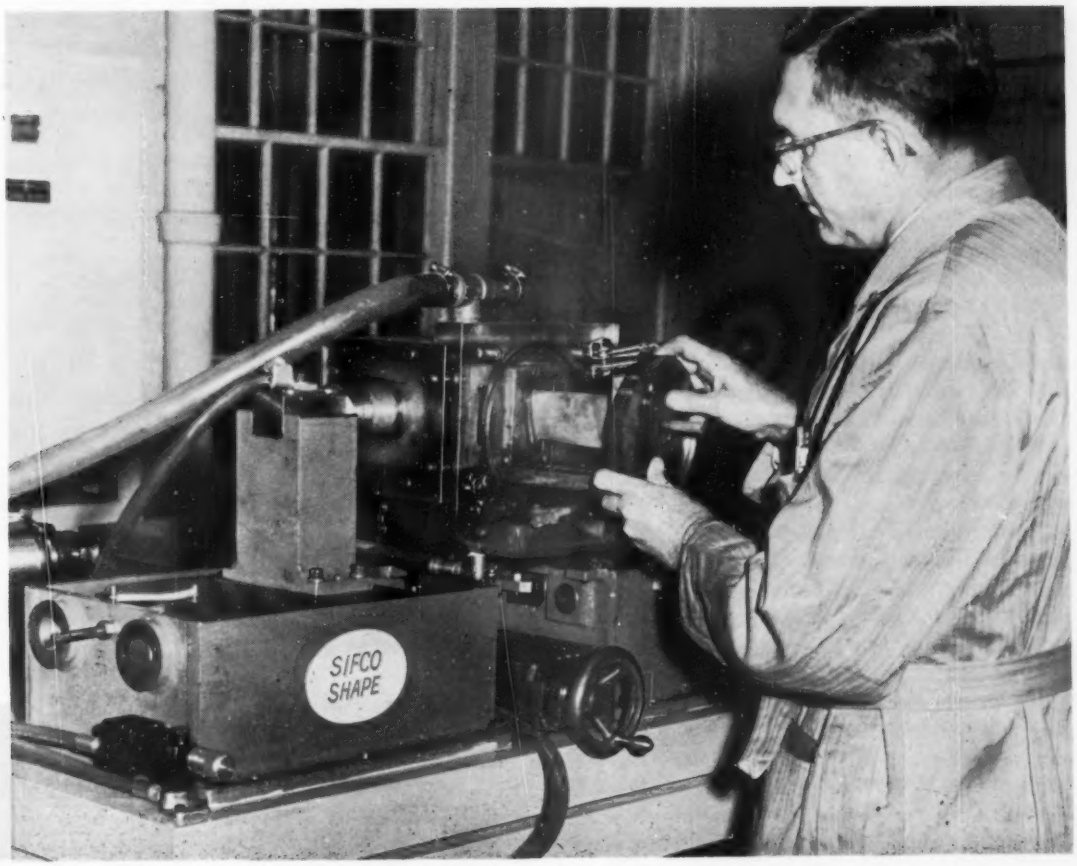


ELECTROLYTIC MACHINE SETUP for trepanning tungsten block. Completed job on stand (left foreground) is a missile case. Five hours—during which the operator is free for other work—are required to remove the 7-inch diameter core.



CUTOFF SAWING performed by electrolytic machining. The blade—⅛ inch in thickness—effects precision cuts with minimum metal loss.

SETUP of turbine blade (below) for electrolytic machining. Forged workpiece, placed between cathodic tools, can be precision machined in minutes.



FASTER HOT FORMING —with low-voltage heating

By K. L. Shaw and R. C. Fuller
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Because it makes higher part temperatures possible, low-voltage heating is desirable for large forming platens, beaded-panel dies, shroud dies and insert form tools. The way in which low-voltage heating methods were developed at Chance Vought is a classic example of applied manufacturing research.

With the advent of hard-to-form Space Age materials, manufacturing engineers have had to develop new forming methods. Probably the most broadly applicable of these methods is elevated-temperature forming, which gives good results when forming aluminum alloys, stainless steels, titanium alloys, tool steels and the various superalloys.

Heated materials are, of course, more ductile than metals at room temperature, and springback and buckling—two of the major problems when forming Space Age materials at room temperature—are virtually nonexistent in hot-formed parts. Complex beaded panels can be hot-formed in one operation, with no need for subsequent hand-straightening or other secondary operations. Consequently, elevated-temperature forming offers an important means for cutting over-all manufacturing costs.

Forming various types of materials at elevated temperatures presents the problem of converting some readily available form of energy into heat energy for heating dies and the work material. Ideally, heating should be fast and easily controlled. The heating system should be capable of achieving elevated temperatures quickly and holding those temperatures over a period of many hours. The life of heating elements, the over-all reliability of the system and maintenance requirements are also important considerations. All of these factors affect efficiency and costs.

With these factors in mind, a manufacturing research program to investigate and develop methods of applying and controlling heat for hot-form dies and hot-form machines was instituted at Chance Vought. Some of the methods considered were:

1. Converting low voltage (0 to 25 v) electrical power to heat by the resistance method
2. Converting higher voltage (110 to 440 v) electrical power to heat by the resistance method
3. Radiant heating from tubular quartz infrared lamps, using electrical power
4. Induction heating due to a magnetic field (from an electrical coil) passing through the material to be heated
5. Radiant heat from gas-fired units.

This article deals with the research and development program for the first method—low-voltage resistance heating. *Fig.* 1.

Power System: The first step in the program was to conduct a survey of existing applications using low-voltage power for heating. Temperature ranges and wattage densities available for the various types of heating elements were also covered by the survey. The shapes and sizes of heating elements, as well as element materials, were studied.

On the basis of the survey, Nichrome V (80 percent Ni, 20 percent Cr) rods were selected as the heating element to be used. This material is highly corrosion-resistant up to 2150 F and has a maximum increase in resistance of 7 percent as it is heated.

With the heating element selected, the next step was to design and build a power and control sys-

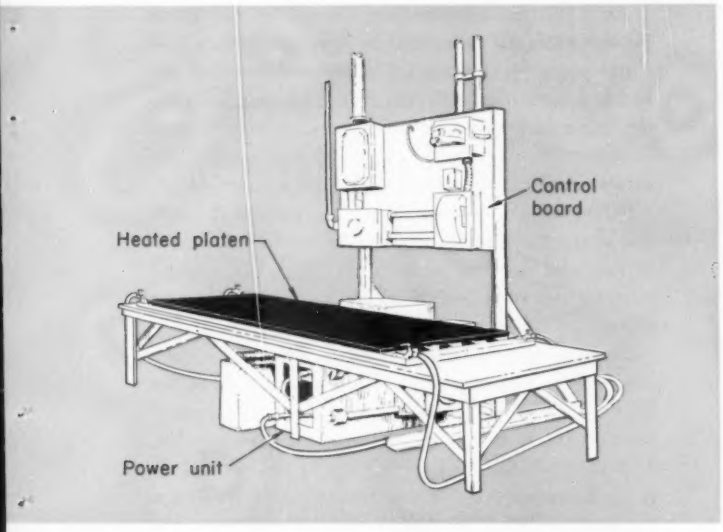
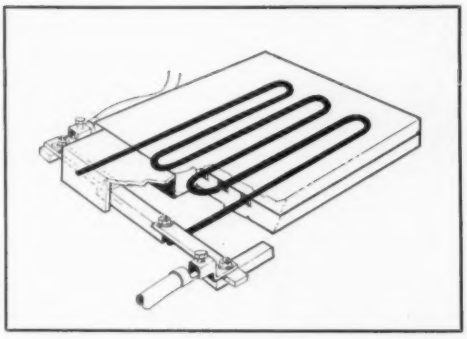


Fig.1. (left) Setup for testing low-voltage resistance heating as a means of heating large platens.

Fig. 2. (below) Small platen used for initial tests of low-voltage resistance heating. The platen is Meehanite.



tem. In the control system, a 460-v incoming line is connected to a fused disconnect switch. From the disconnect switch, the 460-v power is connected to a starter that is turned on and off by a Brown Pyrovane controller. The controller gets its input signal from a thermocouple attached to the platen being heated.

The 460-v output of the starter is fed into the primary side of a 100 kva transformer, which steps down the voltage to 20 v. This 20-v output is connected to the Nichrome rods in a test platen.

The 100 kva transformer used is water-cooled. The water passes through a water pressure switch that is connected into the control. When there is no water flowing, the transformer is automatically de-energized to prevent it from overheating.

Small-Platen Tryout: For initial tests, a small platen was built, *Fig.* 2. The heating element was operated at 20 v. Total power input at this voltage was 6.75 kw or 101 w per square inch of platen heating surface. To facilitate temperature readings, the platen surface was laid out in grids as illustrated in *Fig.* 3. Time-temperature readings for the squares on the grid and typical time-temperature curve for the area at the center of the platen are shown in *Fig.* 4.

After initial testing, the small platen was operated for 26 hours at 1000 F. It was next operated at 1250 F for 114 hours. At this point, the control unit failed. The cause of this failure was not determined. As a result of the failure, the platen temperature exceeded 1700 F for a period of seven hours, damaging the electrical insulators.

When the small platen was dismantled, it was found that the ceramic insulation on the stainless-steel pins was damaged. It was necessary to recoat the pins before the platen could be tested further.

The Nichrome heating strips were not damaged. Since the ceramic insulation can withstand temperatures up to around 2000 F and since Nichrome is highly resistant to oxidation and corrosion up to 2150 F, it is reasonable to assume that the platen was operating at a temperature somewhat above 2000 F during the seven hours the temperature control was not operating. After the small platen was repaired, it was operated for long periods at 1000 F and 1250 F without further difficulty.

The thickness of the oxidation coating that formed on the carbon steel plate was measured to determine the average oxidation rate. Operation for 265 hours at 1250 F produced an oxidation coating that averaged 0.010 inch thick. Thus the average oxidation rate was 3.77×10^{-5} inch per hour at 1250 F. Studies to find means of reducing the tendency of platen surfaces to oxidize at elevated temperature may be undertaken in the future.

Large-Platen Tests: Using data developed during the testing of the small-platen heater, a 36 x 76-inch platen was designed and built. Nichrome rods were again used as heating elements. Two thermocouples were installed—one in the center of the top half of the platen and one in the center of the bottom half. The thermocouple in the bottom half, where the heating strips were installed, was connected to the control unit. The thermocouple in the top half was used only for recording temperatures. The power and control system was the same one used with the small platen.

The first time the heating elements of this platen were energized, there was a great deal of vibration in the platen. This vibration was due to the 60-cycle magnetic field set up in the Meehanite material. In order to lower the noise level, a gap was introduced between the top and bottom halves of

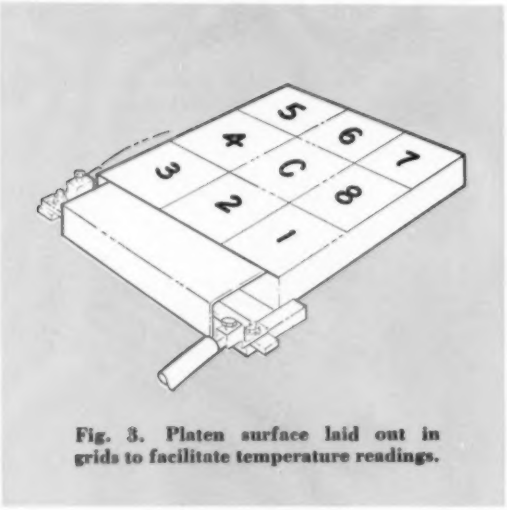


Fig. 3. Platen surface laid out in grids to facilitate temperature readings.

the platen. This was accomplished by placing a piece of 0.010-inch thick aluminum oxide between the two platen sections, *Fig.* 5.

With the intensity of the magnetic field decreased by the air gap, the platen was again energized and heated to 1000 F. Heating to this temperature from an initial temperature of 70 F took one hundred minutes. Some 270 minutes were required to heat the platen to 1980 F. Power input was approximately 60.8 kw, or 22.2 w per square inch of heating surface.

Up to about 1400 F, the platen is heated by two effects. The heat generated by the Nichrome rods radiates into the Meehanite (radiation heating). The magnetic field around the Nichrome rods heats up the Meehanite by causing an electric current to flow in the Meehanite itself (induction heating).

At a certain temperature, known as the Curie point, materials cease to be ferromagnetic. The Curie point for a material whose temperatures are rising is somewhat different than the Curie point for the same material when its temperature is falling; however, the two points are approximately the same. The Curie point for Meehanite is near 1412 F.

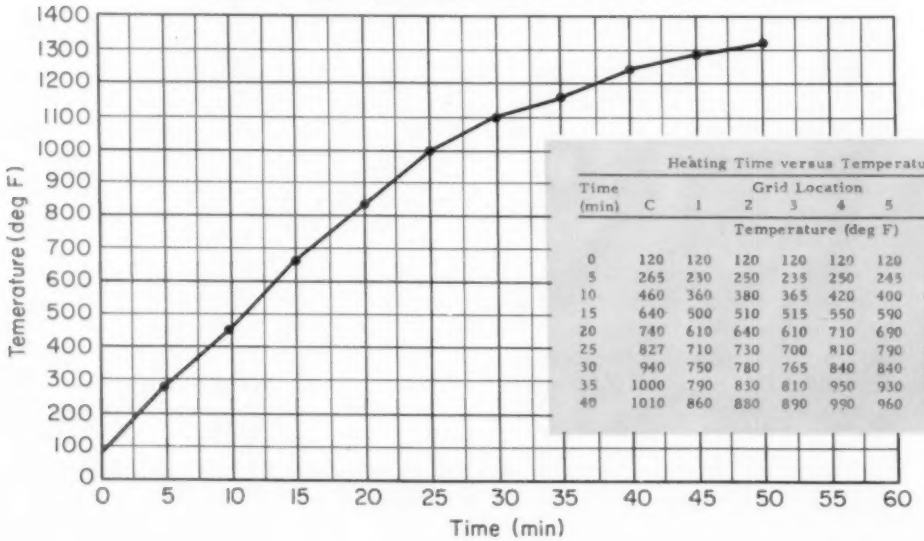
When the platen is energized, the current through the load circuit is expressed as $I = E/Z$, where I is the load current in amperes, E is the applied potential in volts and Z is the load impedance in ohms.

The impedance is expressed as $Z = R + jwl$. Neglecting capacity effects, R is the resistance of the Nichrome wire in ohms, j is a mathematical operator that shows that R and wl are added vectorially, L is the inductance of the circuit in henrys and W is approximately 377 for a frequency of 60 cycles per second. Thus $I = E/R + j\ (377)\ L$.

The resistance of the Nichrome increases with increased temperature. The increased value of R tends to decrease the load current when the applied voltage is fixed. The inductance of the circuit, L, depends on the magnetic material. As the material becomes less magnetic the value of L goes down, which tends to increase the load current when the applied voltage is fixed.

Examination of the data for all tests showed that the load current to the platen increased and the noise level went down as the platen temperature went above 1400 F. There was still considerable heating by induction at temperatures above 1400 F. As shown in *Fig.* 6, when the top half of the platen reached 2100 F, the bottom half was at 1400 F. At this elevated temperature, the resistance of the Meehanite is much higher than at room temperatures so there is still I^2R heat developed in the

Fig. 4. Time-temperature readings obtained with small platen.



Heating Time versus Temperature

Time (min)	Grid Location C	1	2	3	4	5	6	7	8
	Temperature (deg F)								
0	120	120	120	120	120	120	120	120	120
5	265	230	250	235	250	245	255	250	260
10	460	360	380	365	420	400	430	410	425
15	640	500	510	515	550	590	590	600	600
20	740	610	640	610	710	690	710	690	720
25	827	710	730	700	810	790	810	795	810
30	940	750	780	765	840	840	875	880	910
35	1000	790	830	810	950	930	960	950	975
40	1010	860	880	890	990	960	990	980	990

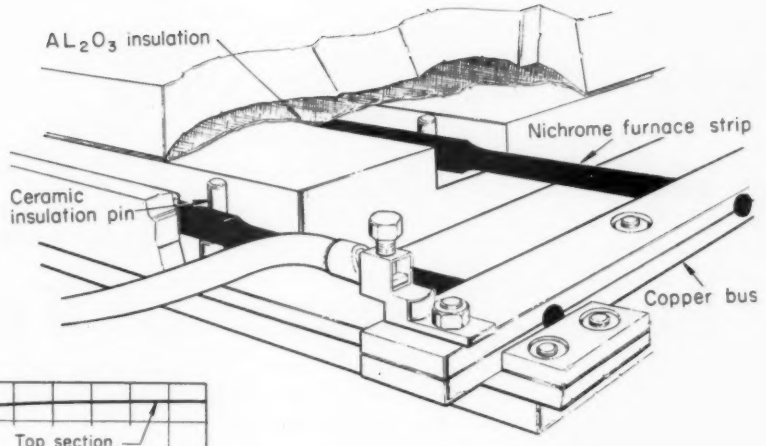
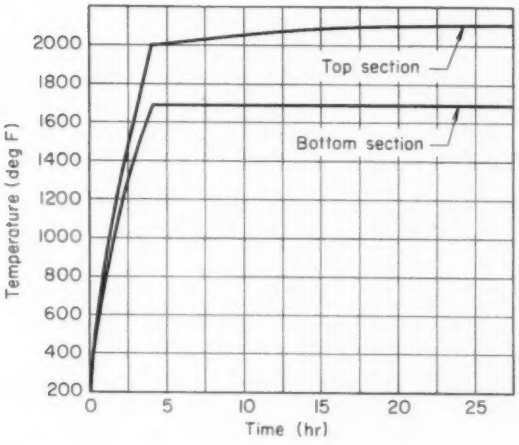


Fig. 5. Construction of the large test platen. The aluminium oxide insulation sheet provides a gap between the upper and lower platen sections.

Fig. 6 (below) Relative temperatures in upper and lower platen sections.



Meehanite due to induction effects.

On the last test, the platen was operated continuously at temperatures up to 2200 F for 50 hours. The platen cracked in both a longitudinal and a transverse direction as it cooled down.

Conclusions: Failure of the large platen by cracking points up the importance of mechanical design. High stress concentrations that could cause cracking of the platen must be avoided.

While good mechanical design will do much to eliminate the danger of platen cracking, the method of operation also influences cracking. With low-voltage heating, the heating and cooling rate can be closely controlled. When heating is slow, an even temperature distribution can be maintained throughout the platen. This minimizes cracking.

The tests show that the use of low-voltage power to heat platens is effective. Temperatures can be accurately controlled, there is no contamination due to combustion products and heating is rapid.

Using voltages in the range of 10 to 20 v eliminates the necessity of providing electrical insulation having high dielectric value. The additional electrical insulation required for high-voltage systems acts as a heat insulator. This is evident from a comparison of a low-voltage and high-voltage system. In the low-voltage system, where only ceramic-insulated pins separate the heating element from the heated material, the temperature gradient between the heating element and the heated material is low. Heat is transmitted through radiation, which is effective above 1500 F.

With the high-voltage system, if the heating element inside the cartridge is at 2000 F, the insulation needed to prevent the voltage from going to ground also establishes a temperature gradient. For this reason, the sheath temperature applied to the heated material is only about 1400 F.

In general, the higher the voltage used in the heating system, the larger the temperature gradient between the electrical element and the material being heated. For the same electrical heating element temperature, a higher temperature can be obtained with low-voltage power than with high-voltage power. Also, with low voltages the problem of grounded heater elements is virtually eliminated. With a 20-v system, the oxide coating on the Nichrome rod acts as an insulator.

For these reasons, low-voltage heating is highly desirable for hot-forming platens, large beaded-panel dies, shroud dies and insert form tools whenever a Nichrome type element can be fitted to the configuration of the heated part.

"It's his air of smug self-assurance I can't stand!"

how to use
POSITIONAL TOLERANCES
Part 3—Inspection Tolerances

By Edward S. Roth
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Positional tolerancing is compatible with standard gaging practice and, by reducing reject rates, it reduces manufacturing costs. This article, the third in a series, shows how positionally toleranced parts are inspected for interchangeability.

MANY PARTS that would perform satisfactorily in service fail to pass inspection. The reason for this is, more often than not, ambiguous tolerances. By changing from conventional bilateral tolerance to positional tolerances, difficulties of this kind can be avoided and acceptance rates improved.

Interchangeability: Positional tolerancing states clearly the interchangeability criteria defining component acceptability for the inspector. To measure true component interchangeability, the inspection must consider feature and datum size. As a result, part layouts, as shown in *Fig.* 1, are sometimes required. A layout is required only when the features inspected are out of tolerance in the same general direction from the datum and when the part datum is not at its most critical interchangeability size (MMC). The setup required to align the part properly is shown in *Fig.* 1a. When the inspector has completed his inspection measurements, he will have the following information:

1. Where the holes should be located (their nominal location from datum)
2. Where the holes actually are located
3. What the actual hole diameters are.

Layout of the inspection measurements is shown in *Fig.* 1b. Simple calculations determine whether the inspected workpiece is acceptable. For Hole 1, positional tolerance is a 0.038-inch diameter circle, since a 0.750-inch fixed gage pin allows a positional tolerance of 0.038 inch. By comparing actual di-

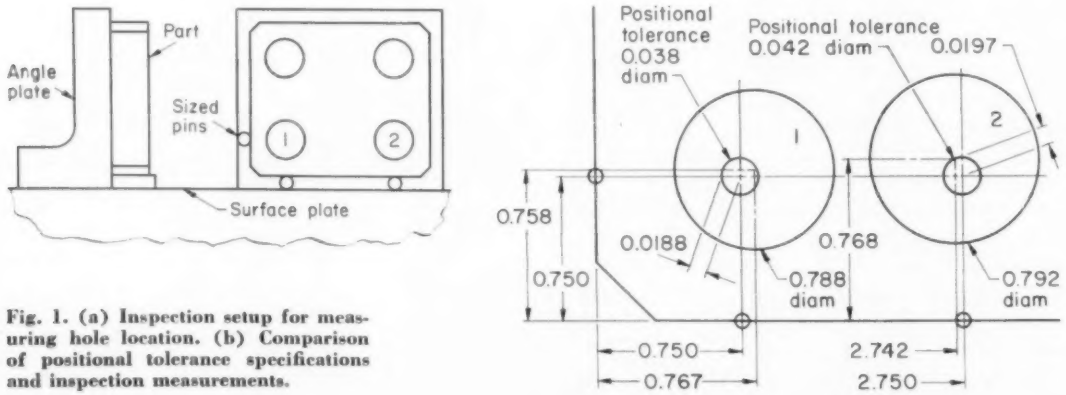


Fig. 1. (a) Inspection setup for measuring hole location. (b) Comparison of positional tolerance specifications and inspection measurements.

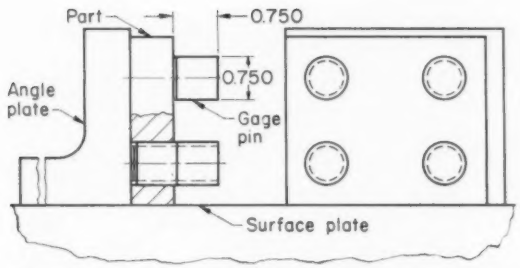


Fig. 2. Component function and tolerancing guides inspection for determining acceptability.

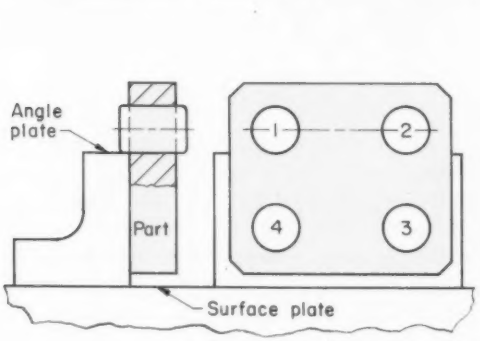
mensions with nominal dimensions, the actual center of Hole 1 is found to be 0.017 inch off nominal center horizontally and 0.008 inch vertically. By solving a right triangle, the hypotenuse or radial deviation of the hole center from nominal is found to be 0.0188 inch. Since this is less than half the positional tolerance allowed (0.038-inch diameter), Hole 1 is acceptable. Hole 2 is similarly acceptable.

The part shown set up for inspection in *Fig.* 2 is to be bolted to a 0.75-inch thick mating part containing clearance holes. Positional tolerance specified for the tapped holes is a 0.030-inch diameter circle. Measurement indicates whether the center line of the exposed 0.750-inch diameter portion of the pins falls within the specified 0.030-inch tolerance zone. The check thus determines interchangeability—whether the shank of a 0.750-inch bolt will actually pass through the clearance hole on the mating part. In this fashion, layout inspectors and inspectors using special gaging would find the same results and agree that the finished workpiece was interchangeable and acceptable.

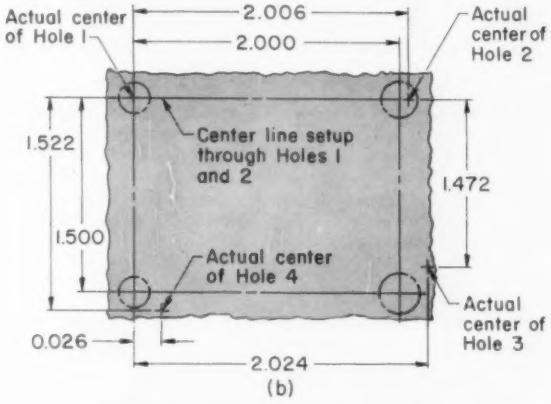
Paper Gaging: Paper gages simulate the shake action of a gage. They can be used when the number of parts produced does not justify building an expensive gage. They provide data on inspection variables—something standard gages do not do. This enables manufacturing engineers to evaluate tool design and also indicates the exact rework required to produce an acceptable part. Paper gages are required for inspecting positionally toleranced parts whenever an inspection determines that two conditions exist—that features inspected are slightly out of tolerance in the same general direction and that the part datum is not at its most critical interchangeability size (MMC).

An inspection setup and paper gage technique is shown in *Fig.* 3. The function of the workpiece is such that the hole pattern is more critical than the actual location of the holes on the workpiece. The specific minimum edge distance can be checked with a round-anvil micrometer. Actual hole size and

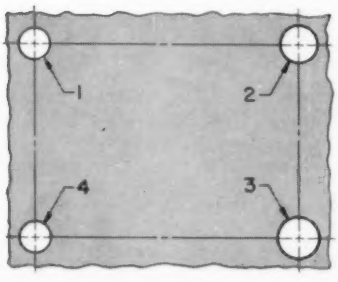
Fig. 3. (a) Holes 1 and 2 are lined up by this setup, (b) Layout of actual inspection results and tolerance specifications. (c) Paper gage to simulate gaging the workpiece. (d) The paper gage (*Fig.* 3c) superimposed on the layout (*Fig.* 3b) indicates the part is acceptable to both inspection and gaging.



(a)

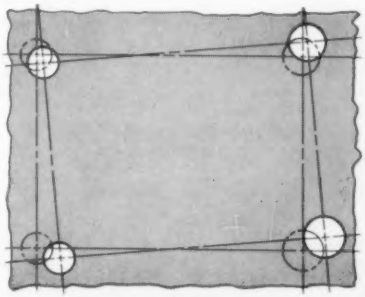


(b)



Hole	Tolerance zone diam
1	0.036
2	0.040
3	0.042
4	0.038

(c)



(d)

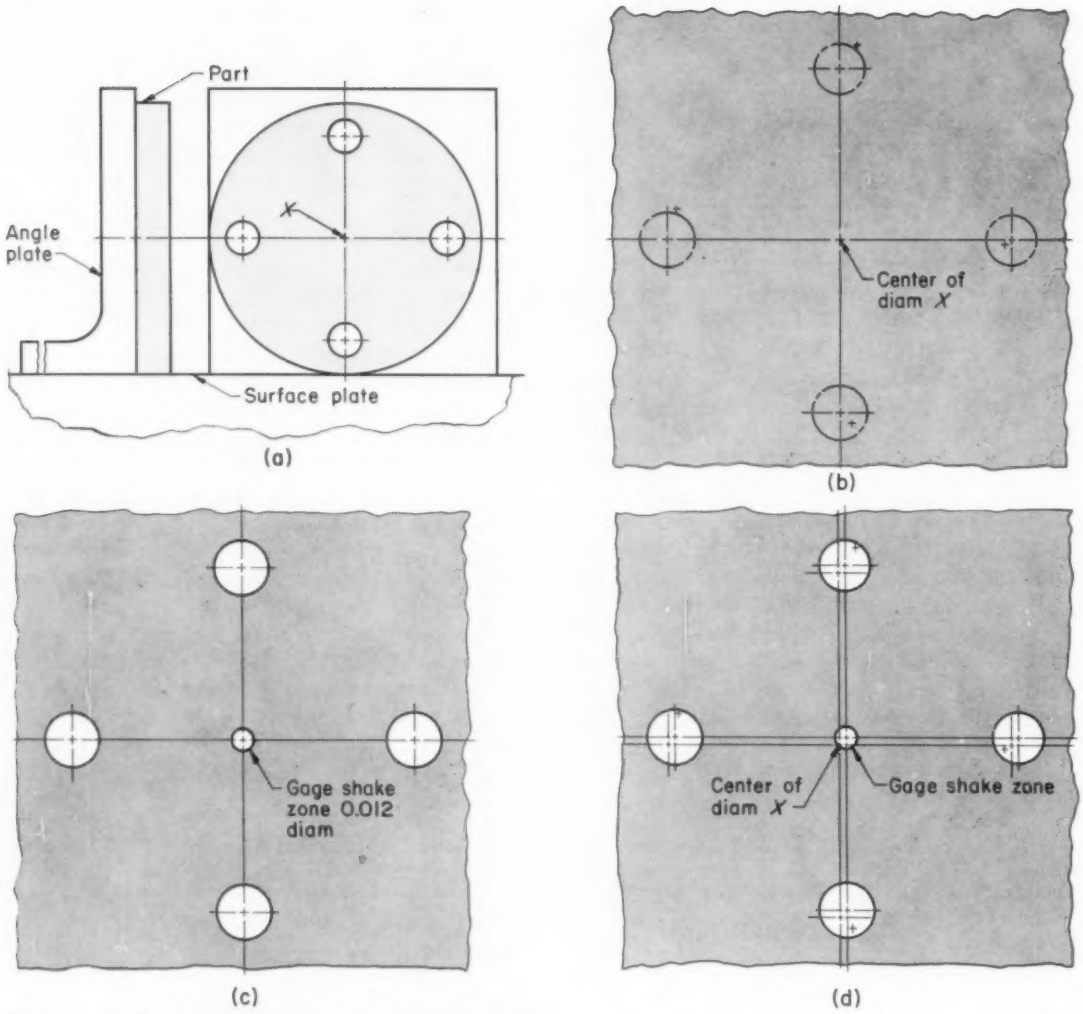
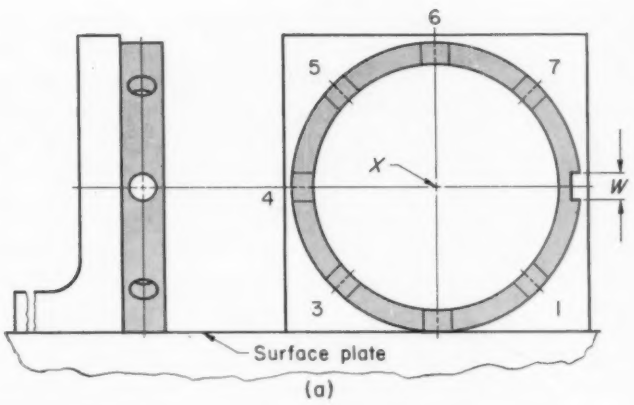


Fig. 4. (a) The inspection setup is made so that measurements are from the actual datum center. (b) Layout of inspection results on an enlarged scale. (c) Paper gage with shake zone and positional tolerances. (d) By shifting the paper gage through the amount allowed by the shake zone, gage shake action is simulated in inspection.

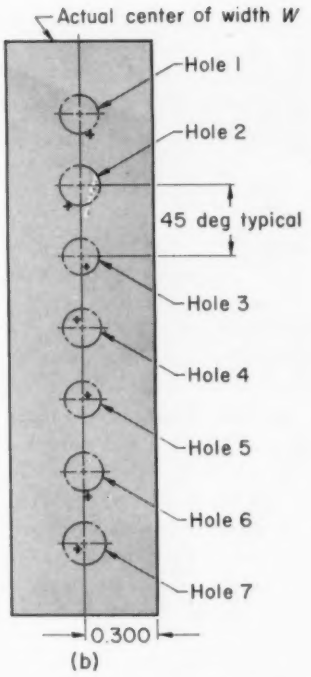
actual center distance between holes is then measured and plotted as shown in *Fig.* 3b. This layout would not be required if the holes were close to nominal (within ±0.015 inch of Hole 1). An enlarged scale (50:1 or 100:1) is used to minimize the possibility of layout errors. The nominal distances between holes do not have to be scaled up. When the holes are out of square, as in *Fig.* 3b, the deviation from nominal should be marked on the layout.

The paper gage, *Fig.* 3c, is prepared from inspection data and tolerance specifications. A positional tolerance of 0.030-inch diameter was specified for the four clearance holes when the holes are at MMC (0.780-inch diameter). A greater positional tolerance is allowed if the holes are larger than 0.780-inch diameter. The paper gage, *Fig.* 3c, is drawn to the same scale as the actual inspection layout, *Fig.* 3b, using the calculated tolerance zones actually allowable. A quick method for determining tolerance zone size is to subtract the gage pin size, 0.750-inch diameter, from the actual hole size for each of the four holes. The paper gage, superimposed on the inspection layout as in *Fig.* 3d, shows that all four of the hole centers fall within their respective tolerance zones. The same results would be obtained using a gage.

The part set up for inspection in *Fig.* 4a would be gaged using a shake gage. The inspector cannot shake or move his setup. If inspection reveals that the datum is not at MMC (4.010-inch diameter), inspection results must be evaluated by layout and paper gaging. If inspection results show that hole centers fall outside their tolerance zones in opposite directions, the part is rejected. The decision to reject agrees with results obtainable by gaging—

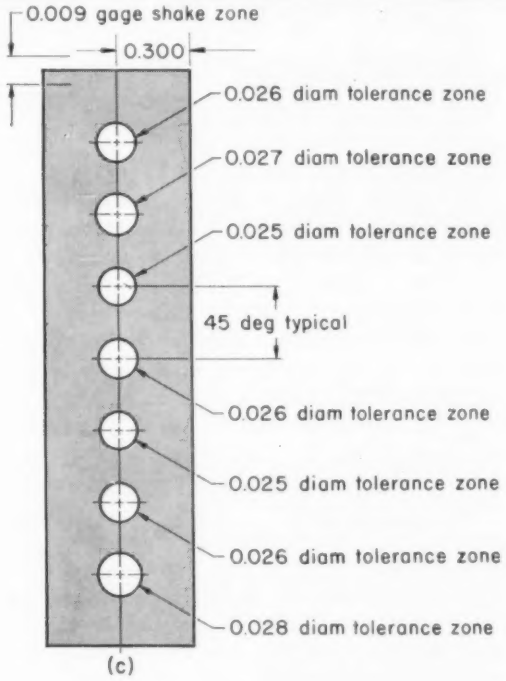


(a)

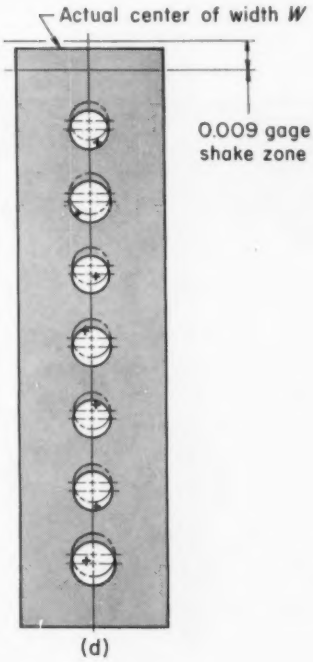


(b)

Fig. 5. (a) The actual center of diameter *X* and width *W* are used as the origin of inspection measurements in this setup. (b) Results of inspection measurements are plotted on a strip peeled off the workpiece circumference. (c) To simulate gage shake action, the paper gage is made to the same scale as the inspection layout. (d) Paper gage indicates acceptability of the workpiece.



(c)



(d)

a gage cannot move in two directions at once. The results could indicate that by enlarging the holes, reworking would enable the part to meet interchangeability requirements.

When evaluation of inspection results is required, a layout of inspection results is made to an enlarged scale. For the part selected to make *Fig.* 4b two hole centers fall outside their positional tolerance zones. But, on this part, the datum diameter measures 3.998 inches. Since the hole centers are outside their tolerance zones in the same general direction and the datum is not at MMC, a paper gage, *Fig.* 4c is required to evaluate inspection results. The gage shake zone (0.012-inch diameter) is the difference between measured part diameter (3.998 inches) and diameter at MMC (4.010 inches).

By superimposing the paper gage on the inspection layout, *Fig.* 4d, it is determined that the centers

of all four clearance holes fall within their respective tolerance zones. The datum (exact center of diameter *X*) also falls within the 0.012-inch gage shake zone. The layout indicates that a gage would accept this part.

An inspection setup for a more complex part is shown in *Fig.* 5a. Diameter *X* and width *W* are specified as datums when they are at their most critical interchangeability size or MMC. Any part having a diameter *X* less than 5.010 inches and a width *W* greater than 0.600 inch would rotate or shake in a gage. This shake effect of the gage must be simulated by inspection if the holes are out of their tolerance zones in the same general direction. Inspection measurements made from the exact center of diameter *X* and width *W* are shown in *Fig.* 5b. Holes 1, 2, and 6 are out of their tolerance zones in the same general direction. Hole 4 limits the amount of gage rotation possible.

A paper gage, *Fig.* 5c is required to determine acceptance. It is constructed from tolerance specifications and inspection measurements. The actual width *W* measured on the part is 0.609 inch, 0.009 inch greater than MMC. A gage could rotate 0.009 inch. This establishes the shake zone used on *Fig.* 5c. Tolerance zones for the holes are the difference between actual hole diameter and gage pin size (0.250 inch). In *Fig.* 5d, the paper gage superimposed on the inspection layout indicates that the part is acceptable. The actual center of width *W* falls within the 0.009-inch wide shake zone and all the hole centers fall within their respective tolerance zones.

By inspecting to positional tolerances rather than bilateral tolerances, the results obtained by layout inspection and by gaging agree. The paper gaging techniques sometimes required assure that inspection will not reject a truly interchangeable part, despite the fact that an inspector cannot move or shake his setup. Furthermore, the paper gages supply data on inspection variables. This enables engineers to evaluate tool design and to indicate the exact rework required to make a part meet interchangeability requirements.

Linear Accelerator for X-ray Metallurgy

Large multilayer vessels (at left) will soon be X-rayed in a matter of minutes, using a linear accelerator that can send X-rays through steel more than a foot thick. The 8 MEV (million electron volt) linear accelerator, called Linac, is being built by the High Voltage Engineering Corp. to examine such metal structures as core barrels for nuclear reactors and high pressure vessels for the petrochemical industry. The Linac produces X-rays by firing high-energy electrons in a straight line down an evacuated tube. The electrons are impelled down the tube by travelling radio-frequency waves that accelerate the electrons until they approach the speed of light. At the end of the tube the electrons strike a tungsten target and produce penetrating X-rays that are beamed onto the material being examined. The X-ray source provides a choice of focal spot sizes—one millimeter and five millimeters. The respective outputs are 1500 and 6000 roentgens per minute. At full power and at a distance of nine feet, the five-millimeter focal spot source can X-ray an 11-inch thickness of steel in about one minute, or a 16-inch thickness in about 18 minutes. The one-millimeter source provides greater resolution and can radiograph an 8-inch thickness in about one minute. A. O. Smith's Atomic and Process Equipment Div. plans to use the Linac for reliability testing of petrochemical and atomic vessels that are operated at high pressure.

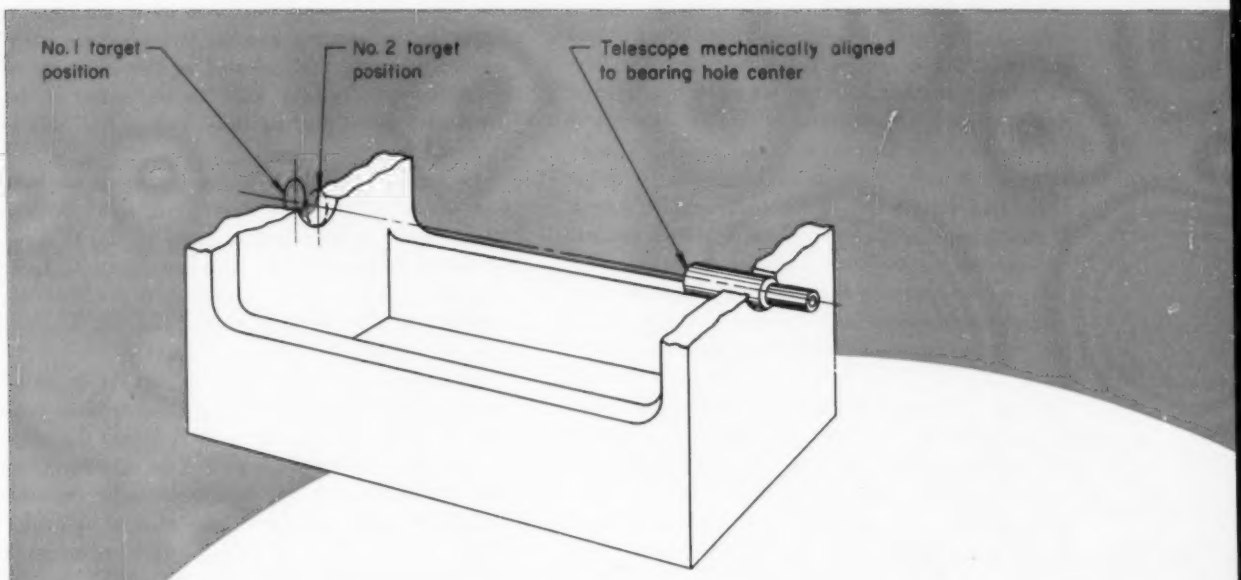


Fig. 1. Method of checking alignment of two bearing holes in a casting.

REDUCED COSTS

sighted through optical tooling

By John M. Miller

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When the possibilities of using optical measurements are kept in mind during product design, manufacturing and assembly costs can be sharply reduced.

THERE ARE MANY WAYS to reduce manufacturing costs. One of these is, of course, to improve manufacturing efficiency—to apply more productive methods, machines and tools. Another approach, sometimes highly rewarding, is to study the product design. Often minor revisions in the design of a part or assembly can make possible major manufacturing cost savings without affecting product performance. For this reason, many companies today call in their tool and manufacturing engineers at the time a product is in the preliminary design stages. Review of designs in the light of their potential effect on manufacturing can be fruitful. Often a simple design change greatly facilitates manufacturing.

Product design engineers are not always aware of the cost-cutting potential of advances in manufacturing methods. This is illustrated by the application of optical tooling. Optical tooling was originally adopted because it satisfies the requirements for increased measuring accuracy in the construction of modern aircraft. It has been discovered, however, that optical tooling methods also provide a means for effecting major manufacturing cost savings. This is particularly true of parts and assemblies that require long-range measurement and alignment.

A case in point is the situation where two widely separated bearings must be mounted in line in a large cast structure. The usual method is to lay out the bearing hole locations by hand and bore the holes in a large boring mill, using a taut wire

for the alignment reference check. The accuracy of bearing alignment is completely dependent on the accuracy with which the holes are bored. One way to improve the accuracy with which hole alignment is measured is to mechanically align a telescope to the center of one bearing hole and position a target in the other hole. Readings are taken with the target positioned at each end of the bearing hole, *Fig.* 1. If the holes are perfectly aligned, the target will be centered on the cross hairs of the telescope.

A second approach is to locate the casting in the correct position with respect to the boring mill spindle axis by using a telescope and appropriate targeting, *Fig.* 2. This is accomplished by roughly locating the casting in the machine tool and finish boring the first hole. After the first hole is bored, the casting is reversed in the mill and a telescope is mechanically aligned in the finish-bored hole. An undersized hole is machined to the layout position so that the spindle of the machine can be seen with the telescope. A target mirror is set in the spindle. Using autocollimation and the target pattern alternately, the casting is oriented so that the axis of the spindle is colinear with the centerline of the previously bored bearing hole. The second hole is then finish-bored to size.

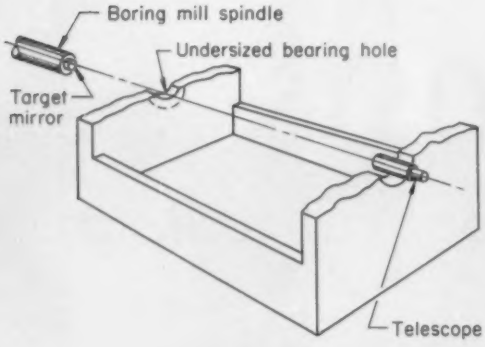


Fig. 2. Telescope, mechanically aligned in a finished hole, is used to align machine spindle for finish machining of rough-bored hole.

Another possiblility is to bring a small machine tool to the casting and locate it in space with a telescope and target, using methods similar to those previously described. All of these methods have been used in one form or another to increase the accuracy of alignment. In some cases, the application also reduces measurement costs.

None of these methods fully exploit the capabilities of optical tooling. A new approach, made possible by optical tooling methods is to cast the holes oversize and to use bearings that fit into the holes loosely so that they may be mechanically fastened in position after they have been aligned optically, *Fig.* 3. The advantages of this approach are obvious. No precision machining is required on the bearing holes; hence, there is no need for a large boring mill. Any precision machining operations on the bearing or on the mechanical fastening device can be performed on small, standard lathes. Thus only a relatively small capital investment is necessary to accomplish a job usually performed on a large and costly machine, with its accompanying overhead. Using this method, a light industrial plant would have the capability of competing with heavy industry to fabricate large products and could do so at much lower costs.

Another possible design solution has its origin in potting techniques developed in the aircraft industry. A castable material can be used to affix a precision detail part—the bearing—to the rough structure, *Fig.* 4. As yet, suitable potting materials have not been developed for this particular application; however, a concentrated effort to develop pot-

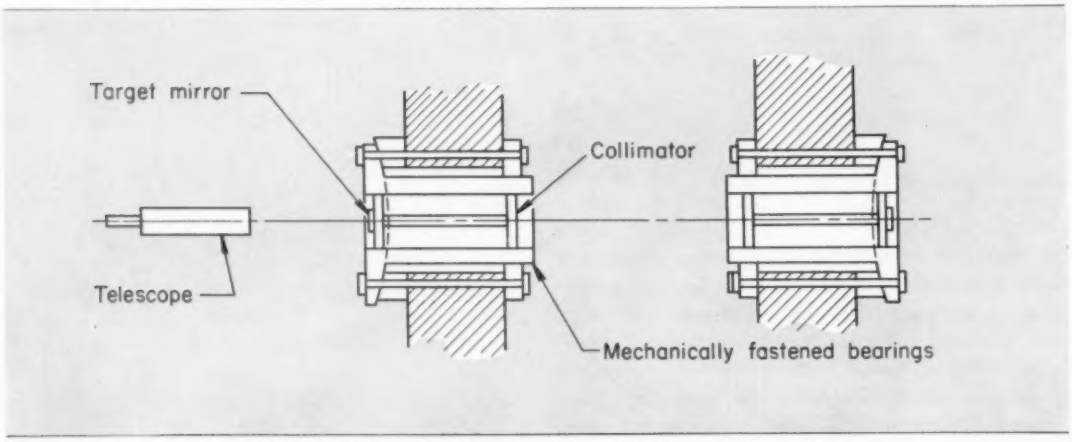


Fig. 3. Mechanically fastened bearings are easily aligned with a telescope.

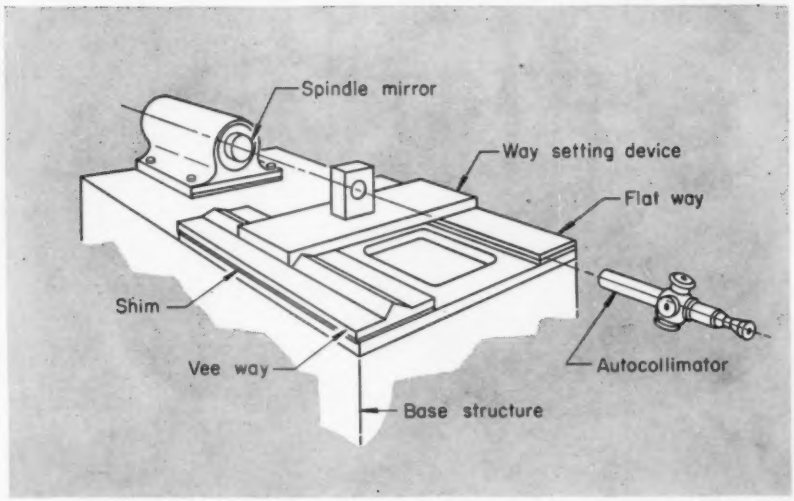


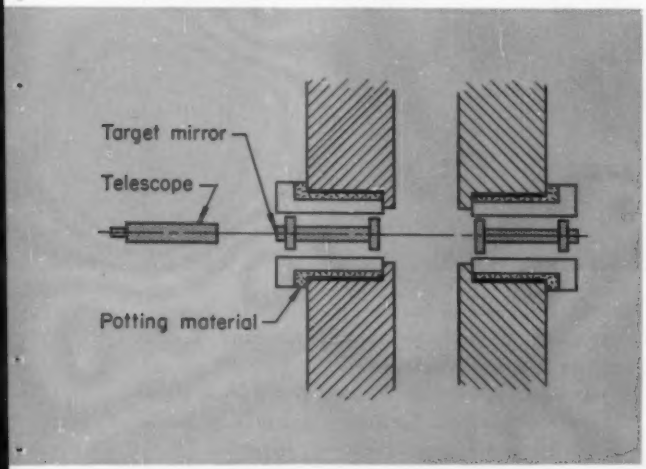
Fig. 5. Ways and spindle of this lathe are aligned with the aid of an auto-collimator and mirror. An epoxy shim is poured between the base and the ways after alignment is completed.

ting materials and methods promises to yield large dividends in the future.

These design solutions have involved the redesign of the bearing area. There are other ways in which the design of the casting could be modified to reduce manufacturing costs without affecting the functional performance of the product. All possibilities should be investigated before the product is finalized.

The use of optical tooling need not be restricted to the aircraft industry. It can effect major savings in many other fields. Optical tooling and potting techniques can be combined to construct a precision lathe, for example. The structural components of the lathe are shown, in simplified form, in *Fig.* 5. The lathe has a rigid base on which a V-way and a flat way are located parallel to a spindle axis. The ways are designed so that they are relatively flexible. They are mechanically fastened to the base.

Fig. 4. A cast potting material may be used to permanently hold bearings after they have been correctly positioned with a telescope.



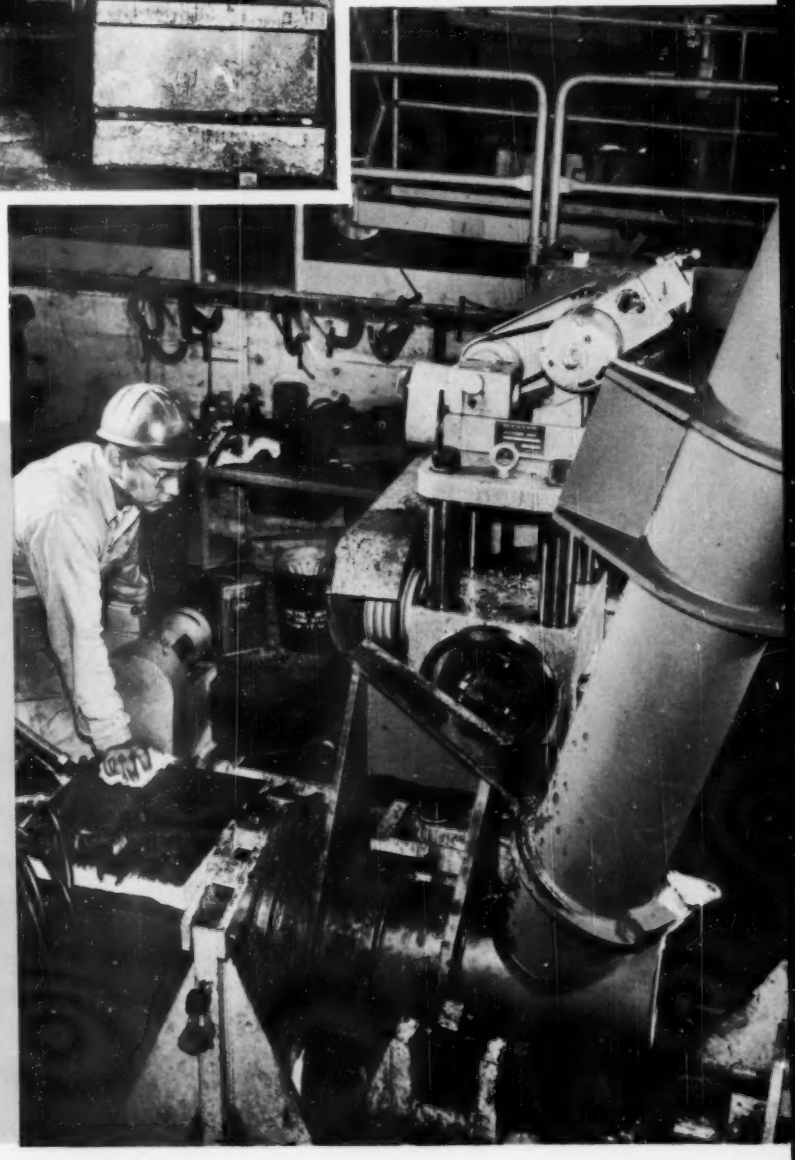
The ways are premachined and are located on the base with the aid of an autocollimator and a special mirror assembly that is supported on a base that duplicates the contact of a lathe saddle. Autocollimator readings are taken at a number of points along the ways and their position is adjusted accordingly. They are supported in correct position by small temporary shims. When the ways have been aligned, a permanent epoxy shim is poured in the space between the ways and the base. The spindle is then located by autocollimation so that its axis is parallel to the ways and an epoxy shim is poured to secure it in its correct location.

This method of constructing a machine tool has several advantages. Since the way and the base are separate, the same material need not be used for both. Materials and heat treatments for bases and ways can be selected on their engineering merit for each application. In the construction of large machines, only the essential parts, such as the ways, spindles and the like need to be shipped to the user. The structure of the machine tool can be assembled or cast on the site of use. The use of reinforced concrete for the machine tool structure is a definite possibility. Concrete is, of course, much lower in cost than steel. A further advantage is that if the ways become worn, it is simpler to bend the ways to an aligned position than it is to rescrape the complete way.

These examples illustrate a new approach to product design. This philosophy is to design with the smallest and simplest precision-machined parts possible, then align these parts with optical tooling. Applying this philosophy requires the cooperation of the product design engineer and the manufacturing engineer. The potential savings make such cooperation worthwhile.

TOOLS at work

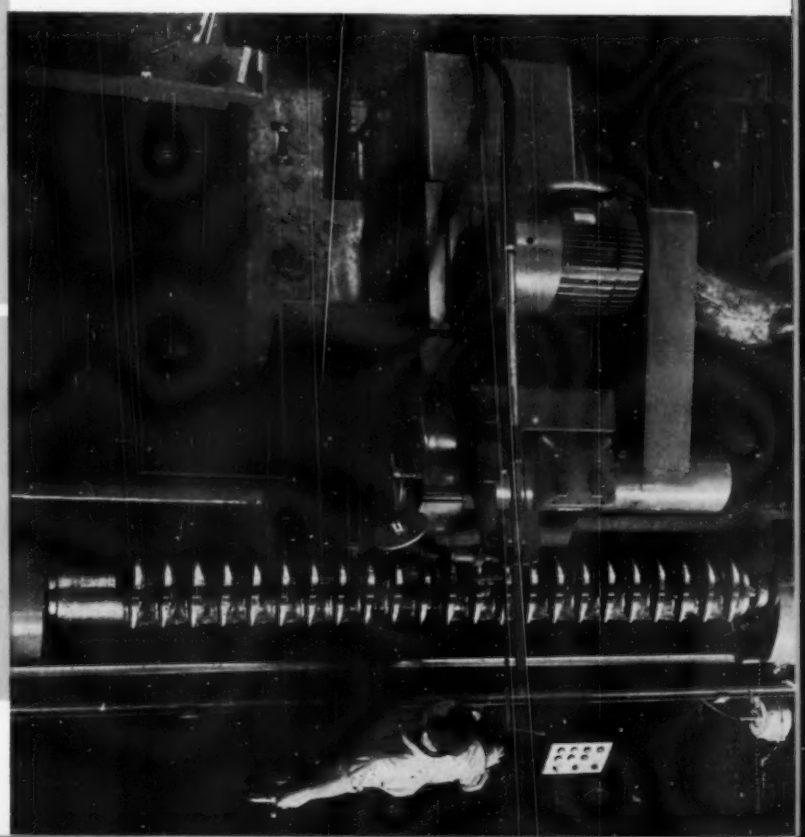
HUGE STRUCTURAL steel workpieces that serve as ground support equipment for the Atlas missile are machined in an unusual fashion at Consolidated Western Steel. The size and weight of the item (dark grey in photo) makes it unwieldy. To move it from place to place in the plant for various machining processes is not only dangerous but uneconomical. So a large holding structure, resembling an oversize sawhorse (light grey in photo) was devised to serve as fixture, work support and machine tool platform for the various milling, reaming, boring and facing operations required.



AS AN INDIVIDUAL machining unit is lowered, a tool supervisor checks alignment. Pallets are located exactly around the large frame (left) and steel locating cones sunk into them to exact specifications. Bases fitted to the Master Machine feed tables are fitted with female end connections to match the cones. The entire machining unit is moved by an overhead crane from position to position in a matter of minutes. Once a unit is in position, machining (below) proceeds without further adjustment. Close tolerances are obtained by positioning the heads on the precision locators. Efficiency is maintained; the work cycles are comparable to more conventional machining methods.

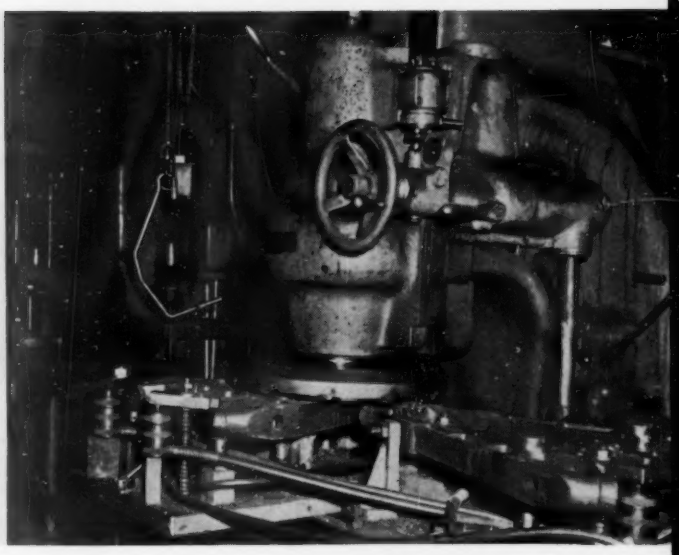
MIXER SCREW, with its three rows of interrupted "flights," is positioned for grinding. Each of the flights is about 2.5 inches wide at its widest point and is tapered on both sides. The metal is 1035 steel, with Rexweld a hardsurfacing metal welded about 0.125-inch thick on the surface. The 24-inch Cincinnati roll grinder can handle work in diameters of 1 to 24 inches, lengths up to 10 feet. During grinding, the work rotates in the same direction as the grinding wheel, with spindle speeds up to 6500 fpm.

TOOLS at work

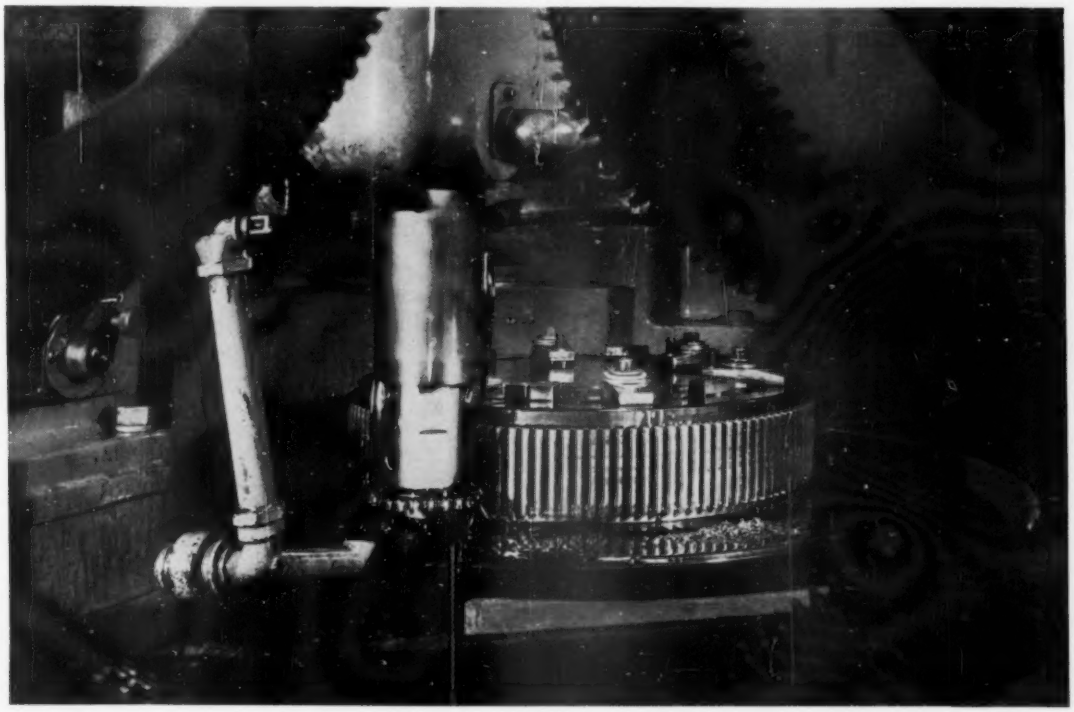


This particular mixer screw (right), made by the Chemical Machinery Div. of Baker Perkins, Inc. for a special continuous mixer, is 112 inches long, with a 16-inch diameter. Grinding is completed in 10 to 15 hours. By previously used methods —lathes and carbide cutting tools— machining time ran between 35 and 45 hours for the mixer.

BOSSES AND FACES of cast iron tractor A frames are milled on a vertical mill at the Verity Works plant of Massey-Ferguson, Ltd. Depth of cut on the A-frames averages $\frac{3}{16}$ inch and the chip load is 0.007 inches per blade. The 12-blade, 20-inch diameter cutter holds surface finish between 90 and 95 microinches. The cutters, a standard Wesson design, are mounted in blade slots that are accurate within 0.0003 inch. The inserts are designed with a $\frac{1}{8}$ inch by 45-deg chamfer rather than a radius. Wiping action of the chamfered cutting edges and low runout of the cutter contribute to the good finish obtained. About 80 A-frames are produced per set of cutting edges, or an average of 640 frames for each set of the general-purpose inserts.

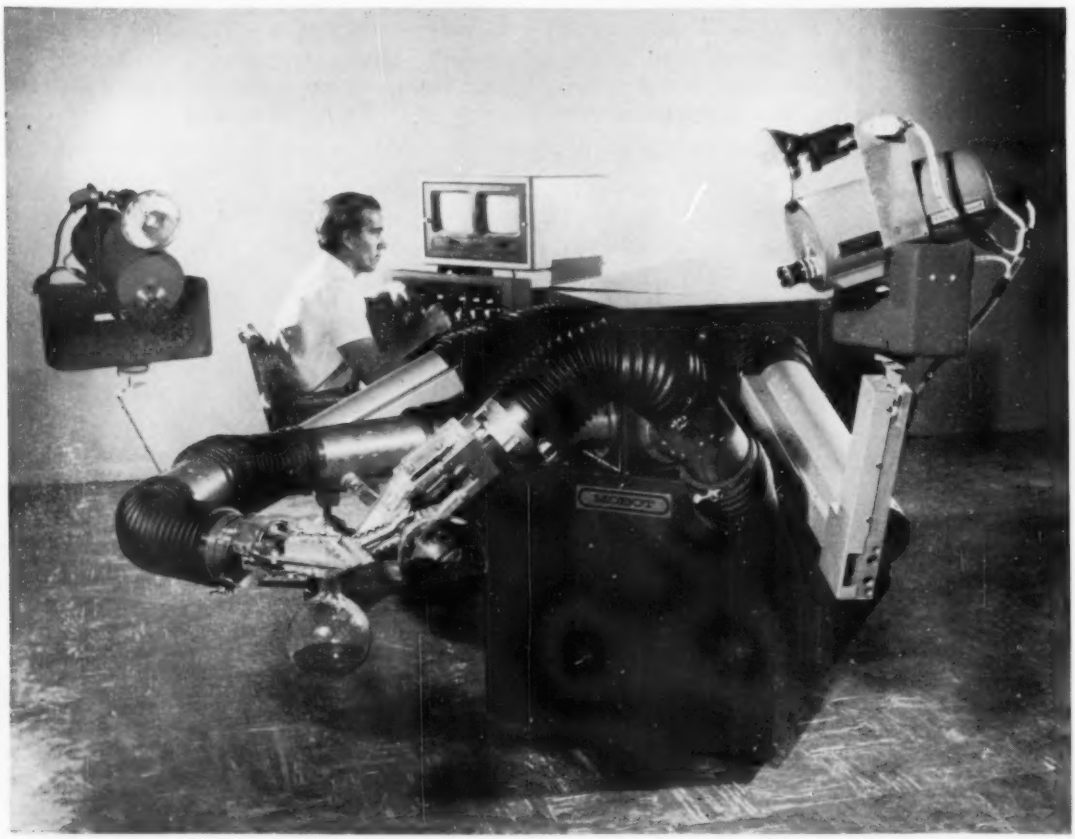


CLUTCH DISKS are cut in stacks of fifty at American Brake Block Div. of American Brake Shoe Company. The disks, of SAE 1035 steel 0.090 inch thick, are gang-cut at 86 strokes per minute using a Fellows gear shaper. Each stroke removes 0.0225-inch of metal and a final depth of 0.03 inch is reached in one revolution. Tolerances are held to 0.0033 inch. Though the gang-cutting is economical, it tends to shorten cutter life—a separate impact occurs as the cutter enters each piece of metal. This results in a stronger tendency toward tool chipping and more heat generation than if one single thick workpiece were being machined. Because of the severe cutting conditions, a switch to a sulfurized mineral oil, Gulfcut 21C, was made and tool life doubled. Though 20 stacks can be run, optimum tool life is obtained by changing tools every six loads, which produces 300 disks.



TOOLS at work

RADIOACTIVE and other dangerous areas, unsuitable for man, are the normal work environment for this mobile electromechanical manipulating system. The manipulating unit is mounted on a three-wheeled vehicle and is steered by a single rear wheel. It receives its commands and transmits data via a single triaxial cable that carries more than 100 command channels, two video channels and power from the control console to the vehicle. The two boom-mounted TV cameras act as eyes to assist the operator in pouring chemicals from one flask to another—TV screens are above the operating console. Each of its arms moves 180 deg in any direction at each of three joints. The wrist can rotate continuously in either direction and the hand telescopes 3.5 inches. A light and delicate touch is provided by the soft inflated pads on its hands—it can replace light bulbs easily. By recording commands on magnetic tape as they are given, the Mobot, designed by Hughes Aircraft Co., can acquire a memory of how given tasks were accomplished. Whenever a task re-occurs, the tape is played back and the Mobot repeats all movements required to complete the task.



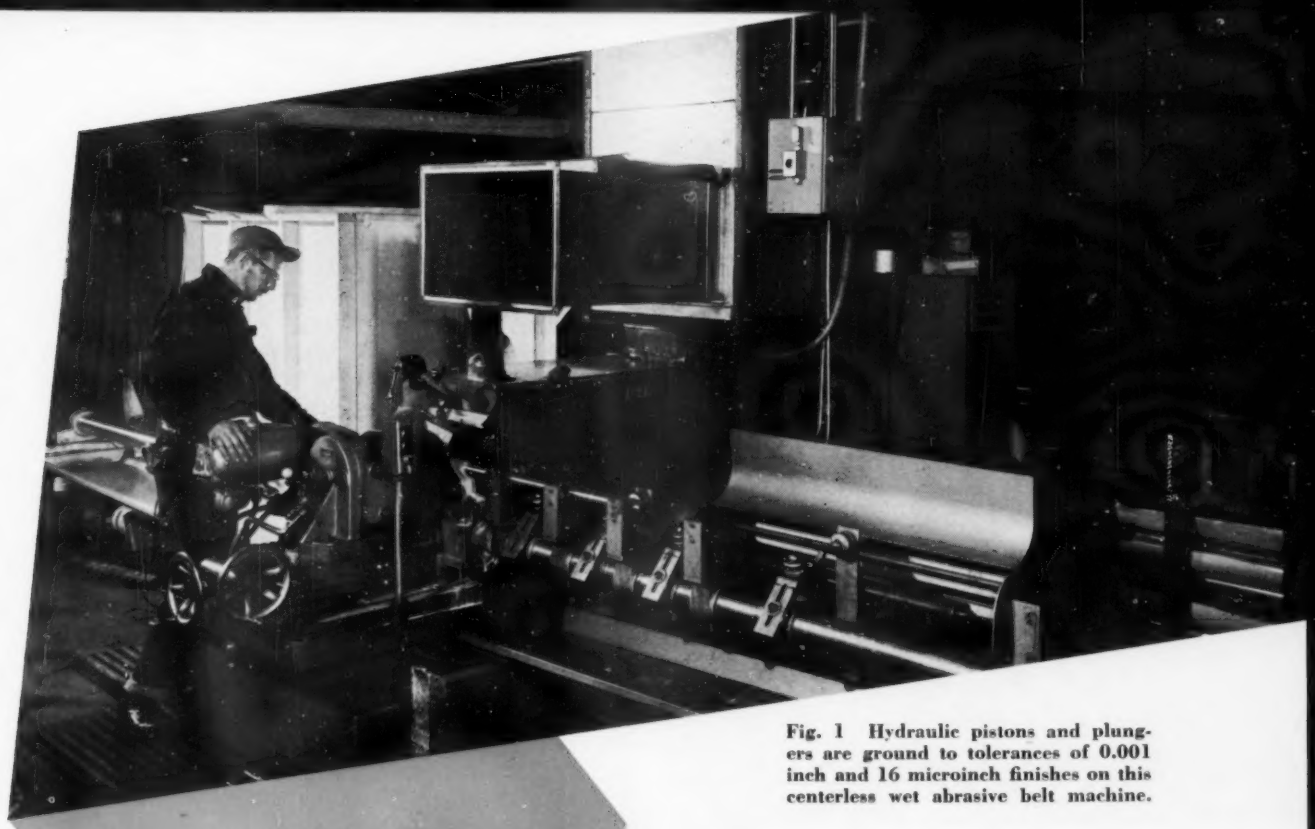


Fig. 1 Hydraulic pistons and plungers are ground to tolerances of 0.001 inch and 16 microinch finishes on this centerless wet abrasive belt machine.

WET-BELT GRINDING

combines accuracy, speed

By O. Mark De Michele
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Ann Arbor, Michigan

Grinding metal from a steel tube at a rate of almost two pounds a minute generates enough heat to stress and expand a workpiece unless the heat is removed. The large area of a belt offers an ample surface for heat transfer; floods of coolant carry it away. Result is that heavy removal rates can be maintained without loss of accuracy.

RODS AND PISTONS sliding in hydraulic cylinders require accurate size and fine finish for proper functioning. They must be nearly perfect to transmit hydraulic pressure in a smooth powerful movement without having fluid under pressure leak past the seal. Cascade Manufacturing Co. used conventional grinding methods to meet the product quality specifications. But production objectives—economy and speed—tend to make achievement of product design requirements difficult. Cascade's manufacturing engineers were partially successful in getting both high form quality and fast production by using a dry centerless belt grinder. Heat generated by heavy metal removal gave trouble, however. The steel tube workpieces were filled with water to help cool them, but even then the heat caused the tubes to expand and forced a waiting period between rough and finish operations.

Changing to centerless wet belt grinding, *Fig.* 1, made it possible to obtain high metal removal rates

Fig. 2 Steel tubes through-feed at 3 fpm and are ground with an average stock removal of 0.015 inch per pass for the rough machining operation.

while maintaining the accuracy and finish required for the product to function properly. The belt grinding machine has a 200 gallon self-contained coolant system to flush both the grinding area and the belt for rapid heat dispersion. With the long bar idler supports shown, workpieces up to 20 feet long can be handled. Workpiece diameters can range from 0.5 inch to 7 inches. The regulating wheel, *Fig.* 2 has an adjustable helix angle for forward and reverse through-feeding. Feed rates are adjustable from 4 ipm to 40 fpm. The belt, 8 x 32 inches, rides on a rubber covered (100 durometer) contact wheel driven by a 40 horsepower motor. Belts travel at 4500 fpm. A reversing mechanism permits progressive through-feed passes in either direction with no intermediate handling.

The steel tube workpieces that are run through this Sundstrand-Engelberg machine vary from 3.5 inches to 6.75 inches in diameter and from 4 to 12 feet in length. Three passes are used to remove an average 0.065 inch of stock. The first pass, rough machining, removes stock at a rate of almost 2 pounds a minute on a 6.75 inch diameter tube. A 24-grit belt is used and the tubes are through-fed at 3 fpm. For the semifinish pass, a 150-grit belt is used, with feed at 6 fpm. The final pass brings the workpiece to a finish of 16 microinches using a 280-grit belt at a 6 fpm feed. Tolerances are held to 0.001 inch for the full length of a 10 foot tube. The belt abrasive is aluminum oxide.

Heat generated by grinding must be dispersed to maintain tolerances and to avoid thermal stress when high removal rates are used. A grinding belt acts essentially like a large grinding wheel in presenting a large surface to the coolant for heat removal—the 132-inch belt is equivalent to a 42-inch wheel in area. With both the large area and ample coolant flooding working to remove heat, grinding provides high metal removal rates—without workpiece distortion—along with the accuracy and finish usually associated with grinding.

Thermally Reversed Magnetism Discovered

Because atomic structure controls the magnetic properties of matter, a through study of magnetism can yield precise information about particles that even the most powerful microscope can never see. For these reasons and because magnetic materials have practical uses, Du Pont has been doing fundamental research on magnetism for several years. In the course of these investigations, manganese compounds were chosen for study because of their interesting magnetic properties and a new material having unusual magnetic characteristics was discovered. It made its first appearance as a slight hump on one of several hundred magnetic strength curves. Three months of further study led to eventual development of the compound—chromium manganese antimonide—a brittle gray substance having unique magnetic characteristics.

The new material responds to temperature in a fashion opposite to other magnetic compounds. Above a certain point it becomes magnetic; below that point it becomes nonmagnetic. Maximum magnetization of other materials occurs near absolute zero and decreases as the temperature is increased. In the new material it appears that there is a critical interatomic dimension at which the magnetic-nonmagnetic transition occurs. The transition temperature can be adjusted by varying the proportion of chromium in the compound which appears to affect the alignment of magnetic moments of the manganese atoms. These properties—never before known—are leading to a better basic understanding of magnetism.

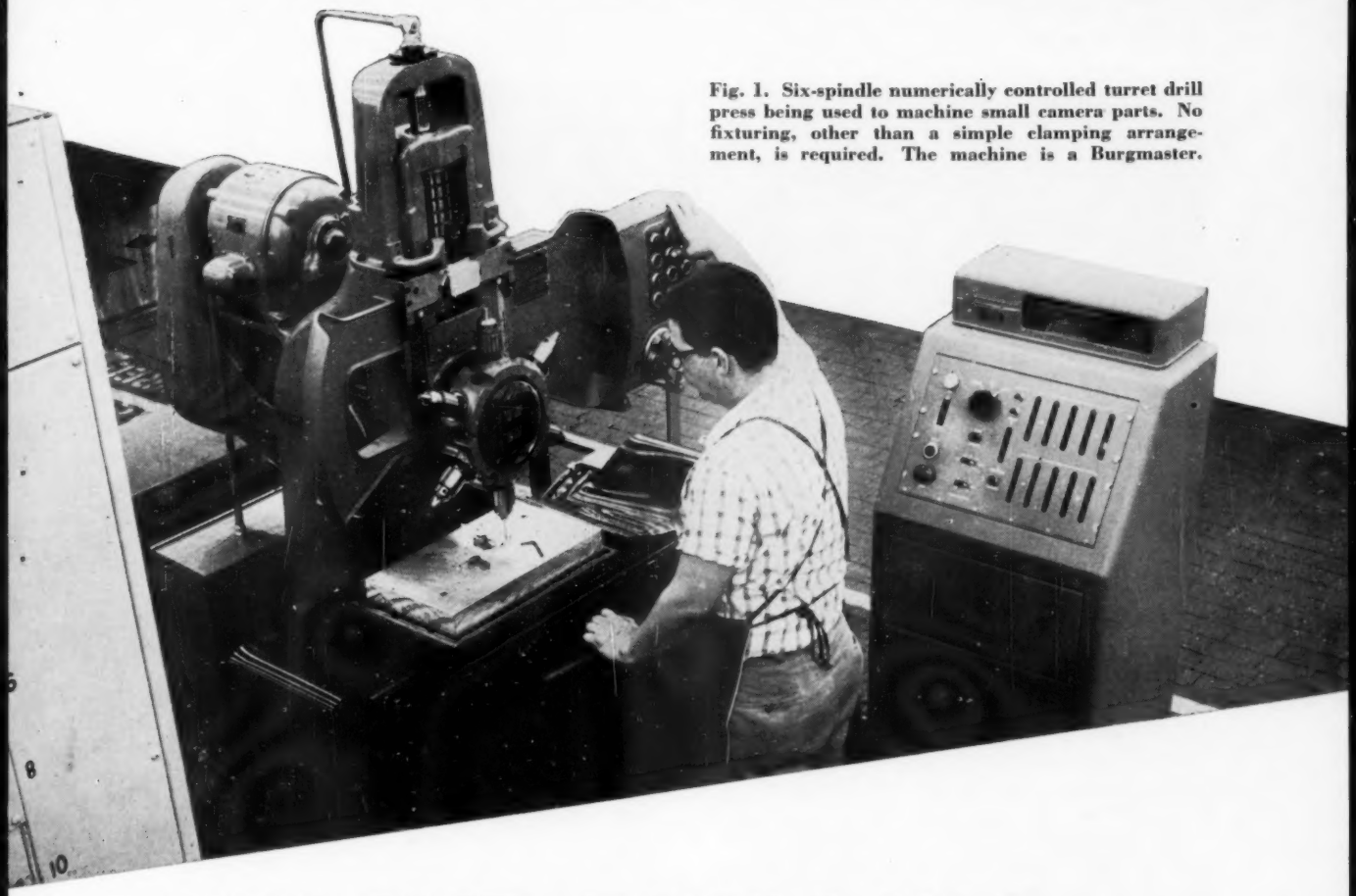

Fig. 1. Six-spindle numerically controlled turret drill press being used to machine small camera parts. No fixturing, other than a simple clamping arrangement, is required. The machine is a Burgmaster.

TURRET DRILLING

—programmed production pays off

More than one-fifth of all machining operations in this country are performed on drilling machines. Numerical control makes it possible to fully automate drilling operations. Result: a dramatic reduction in drilling time and costs.

With the demand for greater machine productivity and accuracy, numerical control has come into its own. Although numerical control was originally developed for contouring operations, the advent of simple, easily programmed positioning systems has made it possible to apply numerical control in almost any plant. Where production runs are short and workpieces have a number of holes of different sizes in different locations, turret type drilling machines equipped with numerical positioning systems are capable of increasing drilling productivity by a factor of ten or more. This same productivity increase is possible with tapping, counterboring, countersinking and boring operations.

The savings in time are impressive. Even more impressive is the simplicity of the tooling required for numerically controlled drilling. Standard tools and simple holding clamps can be used instead of the conventional master jigs incorporating drilling bushings. With simple tooling, tolerances of ± 0.001 inch are being held in many numerically controlled drilling operations. Thus it is no longer necessary to design and build elaborate jigs and fixtures for precision drilling operations. This shortens lead time and cuts costs. In one instance a rocket manufacturer was able to program a part for produc-

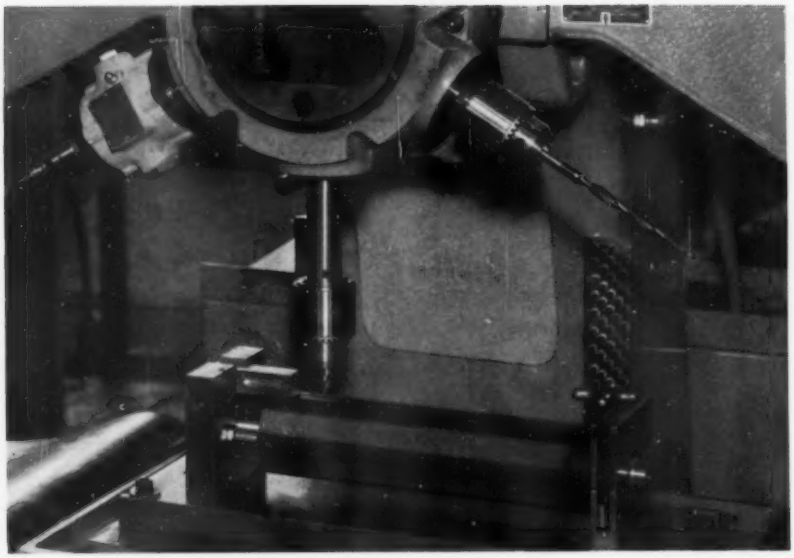

Fig. 2. An indexing fixture is used for drilling rows of holes in a machine stop under numerical control.

tion in 30 minutes. Some 350 hours would have been required to design and build a drilling fixture for this part prior to the adoption of numerical control. An added advantage is that the plant floorspace previously used for jig and fixture storage is now utilized for production.

The numerical control systems used with turret drilling machines can select the spindles in any sequence, automatically position the drilling machine table in two axes, clamp the table while machining operations are being performed and control coolant flow and other auxiliary functions. Often one operator can run two or more machines. Also, it is possible to set up a new job at one end of the machine table while another part is being machined.

The advantages of numerical control are illustrated by the production of a precision camera part, *Fig.* 1. For drilling this part, the machine has been equipped with a 1¼-inch thick 8 by 12 inch aluminum master subplate, which is converted into a holding fixture in a few minutes by drilling dowel location holes and using quick-acting clamps. Such plates have been used for more than 80 different jobs during the first year of operations of this machine. The job shown, which involves performing two operations on each of four holes, was programmed, fixtured and put into production within 90 minutes. Parts were produced at the rate of 100 per hour and the total job was completed in a fraction of the time required for making a drill jig for conventional drilling. Tooling costs were reduced from the $165 required for conventional drilling to $2.75. The entire cost of the installation was returned within six months.

A depth stop for a machine tool, *Fig.* 2, is now being machined in 30 minutes under numerical control, as compared to 80 minutes by former methods. Tolerances of ±0.002 inch are held on all hole locations. The part is mounted in a simple holding fixture that permits hand indexing to the proper locations for each row of holes. Five operations per hole are performed on the 42 holes in the workpiece. The tape was programmed in 10 minutes and punched in an additional 10 minutes. The close tolerances held with the numerically controlled machine produced further savings by eliminating any necessity for subsequent hand reworking. Another benefit was that the operator had sufficient time during the machining cycle to run another machine in the same area.

It is apparent from the operations described that numerical control can have a revolutionary effect on drilling productivity. This, coupled with the short time required to amortize the investment in a control system, should lead to almost universal application of numerical control for short-run drilling.

"Well, if anything, I'd say it was trying to escape."

REFERENCE SHEET

Constructing Nomograms

By **Dimitri Kececioglu**, Consulting Engineer
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ALIGNMENT NOMOGRAMS are useful working tools for engineers in many ways. They save the drudgery of repeated calculations, they enable the expansion of limited data by interpolation and extrapolation, they indicate quickly the direction and amount of change in variables and they present large amounts of data in a handy and concise form. Alignment nomograms can be constructed by purely graphical methods from a Cartesian plot of any single curve, pair of curves or family of curves that meet certain criteria. The conversion methods involved are relatively simple and straightforward and provide an accuracy equal to that of the original Cartesian plot.

Converting a Single Linear Function: Three methods of presenting data are shown in *Fig.* 1—a Cartesian plot, an alignment nomogram where the value of a variable is ascertained by aligning a straightedge appropriately across the scales and a condensed nomogram that does not require the use of a straightedge. To construct the nomogram of *Fig.* 1*b*, the two Cartesian coordinate scales, X and Y, are laid out parallel, some convenient distance apart. To locate the point P, any two convenient points lying on the Cartesian plot are projected as lines on the nomogram till they intersect. For instance, the points $X=0$, $Y=0$ and $X=0.15$, $Y=600$

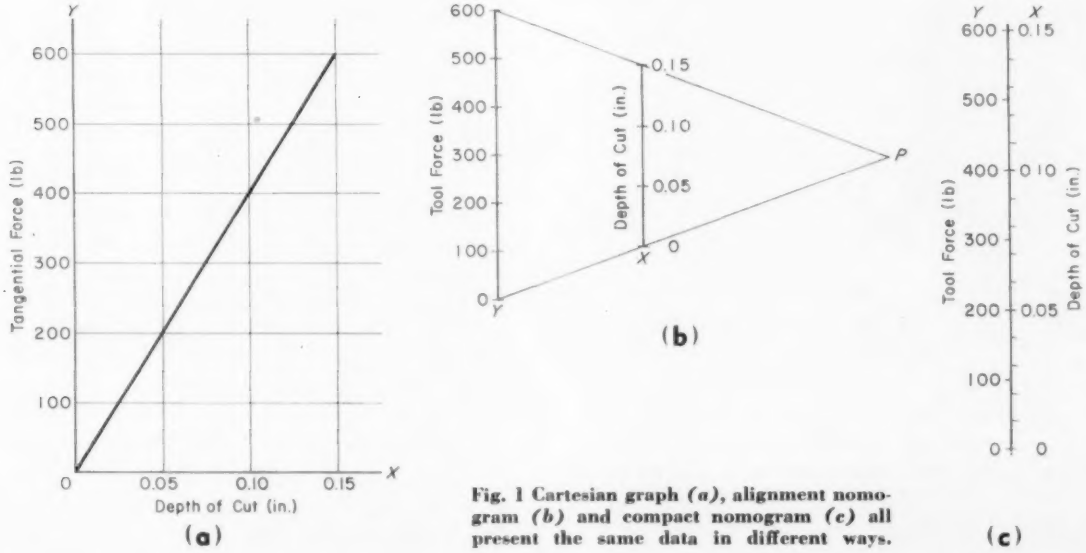
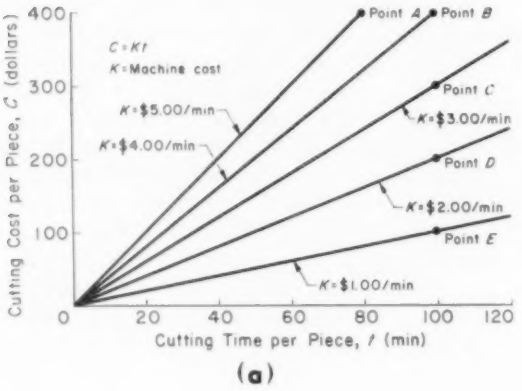


Fig. 1 Cartesian graph *(a)*, alignment nomogram *(b)* and compact nomogram *(c)* all present the same data in different ways.

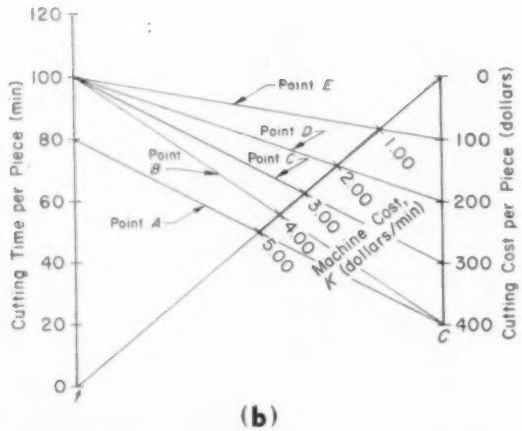
have been used to locate P in *Fig.* 1*b*. When it is convenient to locate P between the parallel axes, one axis must be inverted. The simplest form of the nomogram, *Fig.* 1*c*, is made by drawing the original Cartesian plot so that 0 to 0.15 inch on the X axis is the same length as 0 to 600 pounds on the Y axis. If the original Cartesian plot is not suitably arranged, one axis can be rescaled by simple means to match the other.

Converting a Family of Linear Functions: Relationship between three variables is shown in *Fig.* 2 in both Cartesian and alignment nomogram form. To construct the nomogram from the Cartesian plot, the X and Y axes are first laid out parallel and a convenient distance apart, as previously described. Values on one of the scales must be listed in inverse fashion—in *Fig.* 2*b*, the C scale is inverted. A straight line is then drawn from zero on one scale to zero on the other scale. Points along the middle scale (K scale in *Fig.* 2*b*) are located in a manner similar to locating P in *Fig.* 1*b*. The X and Y coordinates of a point lying on a curve are selected from the Cartesian plot and drawn as a line on the nomogram. The intersection of this line and the middle scale establishes values on the middle scale. For example, from the \$5.00/min straight line on the Cartesian plot, the coordinate values X=80 min, Y=\$400/piece are used to locate the \$5.00/min point on the K scale, by drawing the line as shown to intersect the K scale. Other values on the middle scale are located by repeating the procedure.

In constructing nomograms, the criteria of accuracy and readability should generally be used to guide the arrangement of nomogram elements. For instance, a portion of any one of the three scales in *Fig.* 2*b* could be expanded to obtain greater accuracy. Improved readability can sometimes be achieved by interchanging scales, interchanging the C and K scales in *Fig.* 2*b*, for example.



(a)



(b)

Fig. 2 Variables affecting cutting costs are shown as a family of linear functions on a Cartesian grid *(a)* and as a nomogram constructed by graphic methods, from the Cartesian plot *(b)*.

Rescaling Curves for Nomograms: Nonlinear functions or curves can be rectified or straightened out to obtain scales suitable for nomogram construction. In *Fig.* 3, a straight line is drawn through

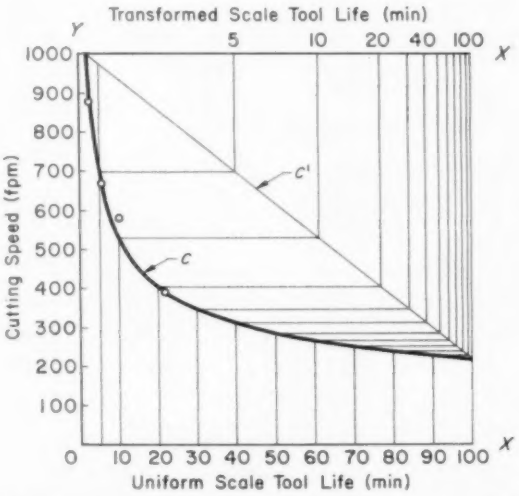


Fig. 3 Transformed linear scale, X' is constructed from a nonlinear function.

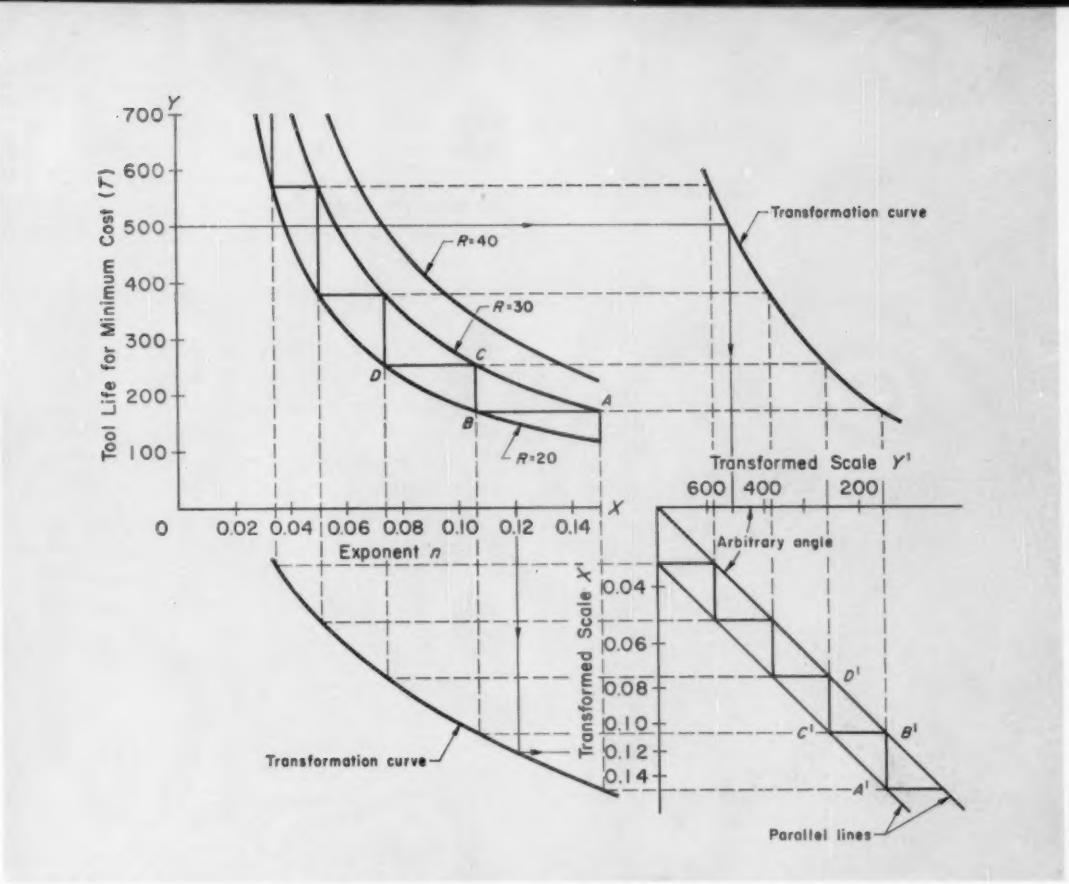


Fig. 4 Using steps, two nonlinear curves are rectified for construction of two transformed scales.

the extremities of the curve C, forming straight line *C'* to be used for transforming the scale. Division points on the standard Cartesian *X* axis are projected vertically to intersect *C*, then horizontally to intersect *C'* at an analogous point. The analogous points are projected upward to form a transformed scale, *X'*. By this graphical solution, a straight line and transformed scale are obtained that can be used to construct nomograms of the type shown in *Figs.* 1*b* and 1*c*.

Two curves in a family can be rectified by using two transformation curves as shown in *Fig.* 4. A series of steps, *ABC, BCD,* . . . , is drawn between the two curves. Diametrically opposite the curves, a similar series of steps—*A' B' C', B' C' D',* . . . , — is drawn between two straight and parallel lines, set some convenient distance apart and at some convenient angle. To set up the two transformation curves, risers are extended to intersect treads, the intersection points establishing the curve. For example, riser *CB* is extended vertically downward and tread *B' C'* is extended horizontally leftward to an intersection point on the transformation curve in the lower left of *Fig.* 4. Similarly, riser *A' B'* is extended upward to intersect a line extended from tread *AB*, thus establishing a point on the transformation curve in the upper right of *Fig.* 4. The

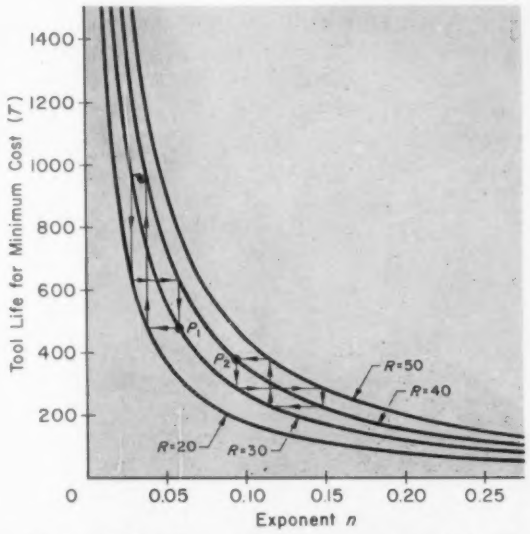


Fig. 5. Bilineality of all curves must be tested to determine if rectification will be accurate.

riser-to-tread projections are continued until both transformation curves are adequately defined.

Once the curves are completed, they can be used to transform scales, as was done for the single curve in *Fig.* 3. Values from the original *Y* scale

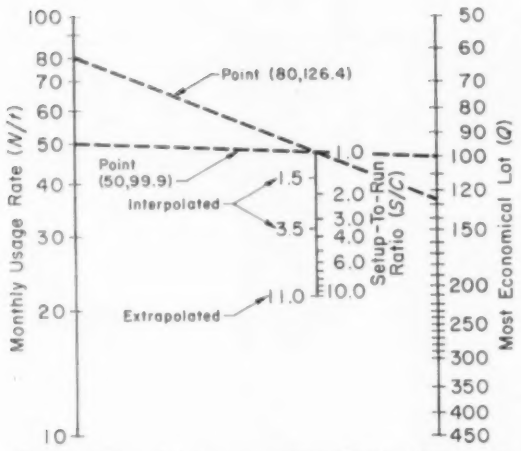


Fig. 6 Interpolated and extrapolated data transferred from the Cartesian plot, *Fig.* 6, increases usefulness of the alignment nomogram.

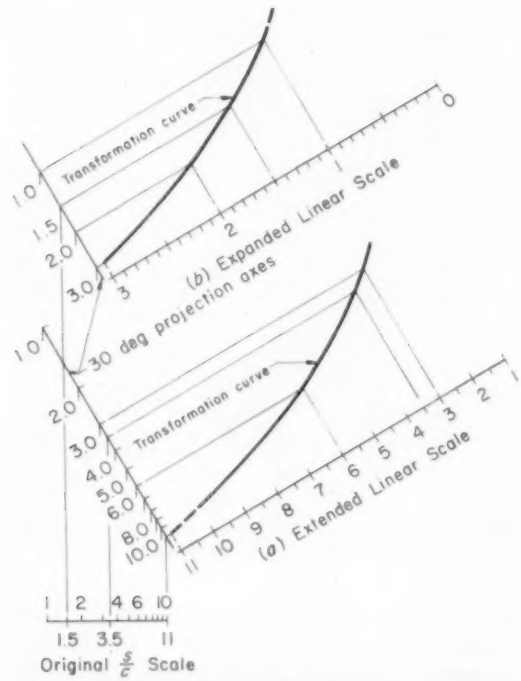


Fig. 7 Graphical method of expanding and extending scales on a nomogram is more accurate than freehand approximations on a Cartesian graph.

for example, are projected horizontally to the upper right transformation curve, then vertically downward to form the transformed scale, *Y'*. With both transformed scales established, construction of the nomogram can be completed, using the method indicated for *Fig.* 2. For improving appearance or readability, increasing the distance between the lines will increase the length of the scales. The angle selected for the parallel lines determines the transformed scale lengths relative to each other.

Rectification obtained from two curves applies to all curves in the family only if all of the curves are bilineal. A test for determining whether all curves are bilineal is shown in *Fig.* 5. Starting at any point *P* on an inner curve, a rectangular chain of lines is projected to the two adjacent curves. Closing the loop, as in *Fig.* 5, indicates that the curves are bilineal. The test should be applied to several points on the curves and to all curves in the family.

When the family of curves deviates from bilineality, attempts to calibrate the third scale result in the formation of a spread-out area rather than a point. The centroid of the area can serve as a point, since it approximates the true function of the family of curves. Accuracy decreases as spread increases.

Interpolation and Extrapolation: Provided that a family of curves is bilineal, new members of the family can be cast in the form of a nomogram, *Fig.* 6. A more exact graphical method of expanding or extending scales is shown in *Fig.* 7. To expand a portion of a scale, the desired range of expansion is drawn at 30 deg. to the original scale, as shown in the upper part of *Fig.* 7. At right angles to the expanded linear scale, a projection axis is drawn. Points are extended from the original scale and the expanded linear scale to intersect and form a transformation curve. Intermediate points on the expanded scale can then be projected back through the transformation curve to the original scale, completing interpolation of new points on the original scale by this method. To extend the scale, or extrapolate, an extended linear scale is used (lower part of *Fig.* 7) in the same fashion.

Extrapolation assumes that the trend established in the family of curves continues into the extrapolated range. Accuracy of the extrapolated curve depends largely on the validity of that assumption. Accuracy of a nomogram decreases as a family of curves diverge from bilineality. In general, an accuracy of about one percent can be expected of a nomogram constructed carefully from a family of exactly bilineal curves. However, the practical accuracy-in-use of a set of data is generally improved when it is converted from Cartesian to nomogram form. Errors in reading are less frequent and interpolation on a scale is more reliable than interpolating between curves.

news

honorary • life • **senior** • **regular** • affiliate • associate • student

see "Membership Changes," page 123.

astme in action

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Student Membership Paces Society Growth

STUDENT CHAPTERS have comprised the fastest growing segment of the American Society of Tool and Manufacturing Engineers within the past year.

The most recent membership status report, released by National Membership Committee Chairman Robert M. Johnson of Minneapolis, shows that rosters of student chapters have soared to a total of 1794 from the 1151 count of a year ago. This gain of 643 members makes up a large share of the total net gain registered by the whole Society in the same period—from 39,585 to 40,414, a rise of 829.

Contributing somewhat to the spectacular student chapter gains has been the chartering of four additional groups during the year, at McKeesport Center and the Ogontz Campus of Pennsylvania State University, the Western Ontario Institute of Technology at Windsor, and the Muskegon (Mich.) Community College.

Largest Has 251 Members

But much of the net student chapter growth has been internal, among the other 28 chapters. For example, the largest of them all—Erie County Technical Institute near Buffalo—has registered a membership this year of 251 students, compared to 156 at the same time last year. Other chapters that have posted significant gains include Alfred State Tech at Alfred, N.Y., from 31 to 84; Wentworth Institute, Boston, from 49 to 87; Mohawk Valley Tech, Utica, N.Y., from 61 to 92; Lawrence Institute of Technology, Detroit, from 58 to 110; and California Polytech, San Luis Obispo, from 87 to 145.

Two More Student Chapters in Offing

Noting that such student chapter growth augurs well for the future health of the Society and of tool and manufacturing engineering in general, National Education Director Gilbert E. Seeley reported that two more student organizations were joining ASTME ranks. Scheduled to be chartered by National Director Charles M. Smillie just at the time this magazine went to press was a student group at the Detroit Engineering Institute. National Secretary Francis J. Sehn was slated to act as chartering officer at the launching of a student chapter at Flint Junior College on Feb. 16.

Total Student Members

Besides the 1794 members in student chapters, there are 1378 other student members who are affiliated with senior chapters, making a total of 3172 student members in the Society. The student membership is second in number only to senior members among the seven membership categories.

During the past year, eight senior chapters with a total of 852 members have been chartered. They are Framingham, Greenville-Spartanburg, Manila, Mexico City, Chattanooga, Danbury, Adelaide (Australia), and Skokie Valley.

Heart Is in the Right Place

Dr. W. J. Kolff, head of the Department of Artificial Organs at Cleveland Clinic, holds the artificial heart he described recently to members of Akron ASTME chapter. With him are Clyde Fagan (center), Akron chairman, and S. Harry Norton, retired consulting engineer of Thompson Ramo Wooldridge, Inc., who designed and fabricated parts of the heart. Sac, diaphragms and aorta were made of a polyurethane plastic developed by B. F. Goodrich. Several ASTME chapters have offered help to the medical profession in improving medical equipment.

Canada's Economy Analyzed

IN A CANDID ANALYSIS of what's economically wrong with the United States' great northern neighbor, a leading Canadian industrialist told 157 persons at Hamilton District chapter's executive night meeting:

"If there is one common description which I think we can all agree on for Canada, it is disunity. . . . I believe we are in for real trouble unless we re-evaluate our situation and do something to create Canadian unity."

H. George DeYoung, president of Atlas Steels, Ltd., Welland, Ontario, declared that Canada was comprised of a very heterogeneous federation of different economies, with each geographical area and each economic group maintaining the supremacy of its own problems and the right to solution of those problems for local advantage. In manufacturing, he added, the problem is confused and sacrificed by the influence of subsidiary companies owned outside Canada, mostly by firms in the U.S.

DeYoung recently returned from the Fourth International Conference of Manufacturers in London, attended by 200 representatives from the six nations of the Common Market, from the "outer seven," from Canada and the U.S., and from Latin America.

He told Chapter 42 of ASTME that he was particularly impressed by the presence of a common goal (eventual political unity) and by the great degree of organization among Common Market nations. Government, labor and business were so organized, he found, as to most effectively encourage competitiveness and full employment.

DeYoung urged representative councils, patterned after Common Market groups, from all segments of the Canadian economy—agriculture, labor, industry (export and domestic), finance, raw material production—be set up to contribute on a regular, formal basis to the policy-making of the government.

Before this, however, it is necessary for Canada to settle on its goal, he said. "In any modern management, it is the duty of the manager to set the goal—establish the philosophy—create and build the organization—and man this organization and direct its activity toward the achievement of its goal.

"I leave you with the thought that our central government must set the goal of maintaining and improving the status of *all* segments of the economy. And I suggest that the solution to the Canadian problem—unification—must be Canadian."

Society's Fifth-Year President Dies

FRANK A. SHULER, 79, who joined the Society in its first year of existence and assumed the national presidency five years later, died in Detroit on December 27. He was well-known throughout the automotive industry for his work in developing methods of rear axle housing fabrication.

An excellent example of the self-made engineer, Shuler climbed to prominence in the field of mass production by the ladder of practical experience. Born in Canton, Ohio, he began his career in 1907 with the Timken-Axle Co. Later he moved to the company's Detroit branch as master mechanic.

After owning and operating the Shuler Axle Co., he became master mechanic of the Chrysler Corp.'s Highland Park plant in Detroit. He remained with Chrysler until his retirement some years ago—a total of nearly 20 years of service.

In 1953 Shuler received a certificate of service for his work with the National Production Authority, which involved touring the nation to make progress reports for plants with government contracts. The award was presented ". . . in appreciation of service rendered to the United States Government in time of national emergency and in official recognition of the outstanding experience and ability for which he was selected to serve . . ."

As president of the Society, Shuler was a man of action and results. The young organization, still in the formative stages, doubled its size under his administration. But the biggest event during his presidency was the first ASTE machine and tool exhibition, held in Detroit in 1938. And largely due to Shuler's planning and management, the show was a great financial success as well as a success in gaining national recognition for ASTE and setting a precedent for such Society-sponsored exhibitions.

The Society's Joseph A. Siegel Memorial Award was presented to Shuler in 1957 with this tribute: "Honored past president of the Society, prominent in its founding activities . . . his sound administrative planning in the early days was indispensable in structuring the Society into a vital organism . . . a production executive whose achievements contributed largely to mass automotive manufacture."

He is survived by his wife, Gene; eight children; a sister; and two brothers.

Membership Changes Coming Up for Vote

A NEW MEMBERSHIP CADRE will be perhaps the most far-reaching proposal on a referendum ballot that is due to reach ASTME's voting members some time soon after they get this issue of THE TOOL AND MANUFACTURING ENGINEER.

Recommended by the Long Range Planning Committee (whose full report is published elsewhere in this magazine), the new Society membership lineup was endorsed by the National Board of Directors at the Los Angeles meeting as the most effective way of raising the professional level of the Society.

The plan would materially upgrade the qualifications for Senior Member and would add a new classification of Regular Member. The present Junior Member category would be eliminated.

This article will explore the changes in detail and will attempt to tell why they have been recommended, in order to help the voting member cast an intelligent ballot.

Constitutional amendments must be approved by the membership; changes in the Bylaws can be made by the Board of Directors. Final adoption or rejection of the membership proposal—along with other constitutional amendments contained on the ballot—will be decided by a majority of the votes cast. (The steps which must precede the actual mailing of ballots to the membership, along with other constitutional provisions on who can vote and who cannot, will be found on Page 126 of this issue.)

Mainstay of the Society

Historically, of course, the mainstay of the Society has been the Senior Member. He will continue to be so.

Recognizing that Senior Members now and in the past have made up more than three-quarters of the Society's total membership roster, the Long Range Planning Committee approached the problem of upgrading membership requirements with a great deal of deference. The Senior Member grade, they well knew, includes the men who have contributed their sweat and tears and their considerable talent to the Society during its formative years. In the long-range planners' opinion, nothing should be done or even contemplated that would result in any downgrading of this group.

Upgrading Would Be Transitional

In short, the ultimate goal of raising the membership stature should be a transitional procedure, the Society leaders decided.

One of the most emphatic points made by the LRP Committee, and one of the most justifiable in the opinion of most Society leaders, was the so-called "grandfather" clause which accompanied the LRP recommendations on membership qualifications:

"Any Society member classified as a Senior on the date of passage of this amendment to the Constitution shall continue to hold the grade of Senior Member in the Society as long as he shall remain in good standing."

With this point made clear, the LRP Committee recommended that the section of the Constitution stipulating qualifications for future Senior membership in ASTME be revised as set forth below. This revision incorporates all changes submitted by the National Constitution and Bylaws Committee, and has been approved by the National Board of Directors. If approved by the members in the upcoming referendum, the Constitution will read as follows:

Sec. 4. A Senior Member must possess a degree in science or engineering from a recognized school and/or profes-

honorary • life • **senior** • **regular** • affiliate • associate • student

sional registration, plus experience, or the equivalent thereof as specified below and a minimum age of 30.

(a) An applicant possessing a degree as outlined above and/or professional registration must, at the time of application, have five years experience in one or more of the following categories:
  (1) A Tool or Manufacturing Engineer of recognized ability to plan the order of operations, layout or supervise the design and manufacture of tools and equipment.
  (2) An executive having knowledge of tool and manufacturing engineering and having responsibility for manufacturing any industrial equipment.
  (3) A tool, die or machine designer with experience in the design of tools, dies, gages, machines, and accessories for any material.

(b) An applicant not possessing a degree and/or professional registration, as outlined above, and having reached the age of 30, may also qualify for this grade of membership upon completion of ten years experience in one or more of the above three categories.

(c) Academic training in a recognized technical or engineering school may be accepted for experience on a year for year basis.

(d) Senior Membership shall carry voting rights.

New Grade of Regular Member Provided

Foreseeing that a void would be left in the Society between the upgraded Senior Member classification and the present Junior Member grade, the long-range planners urged creation of a new category to be known as Regular Member. This grade would encompass the former qualifications of Junior Member and the rights of former Senior Members. In effect, the new Regular category would absorb present Junior Members and a portion of future applicants who would fall under present Senior qualifications if such qualifications were continued.

The grade of Junior Member would be eliminated. All members in that grade at the time of final passage of this amendment would be automatically advanced to Regular Member.

If approved by a majority of voters in the referendum, the Constitution will read as follows as regards Regular Members:

Sec. 5. A Regular Member must be at least 20 years of age and shall qualify as any one of the following:

(a) A Tool and Manufacturing Engineer who is a person of recognized ability to plan the order of operations, layout or supervise the design and manufacture of tools and equipment.

(b) An executive having knowledge of tool or manufacturing engineering and having responsibility for manufacturing any industrial equipment.

(c) A tool, die, or machine designer having five years experience, this to include tools, dies, gages, machines, and accessories for any material.

(d) Academic training in a recognized technical or engineering school may be accepted for experience on a year for year basis.

Regular Membership shall carry voting rights.

The major changes proposed in the rewriting of these sections of the Constitution, in summary, would be to raise the qualifications for Senior Membership(i.e. 10 years instead of five years experience; minimum age of 30 instead of 25) and to replace Junior Member with Regular Member and raise the qualifications for that grade (i.e., more than five years experience instead of under five years).

The LRP Committee, in evolving the new structure of membership, made it plain that individual affiliation with the Society is not a one-way street with unilateral benefits for the member. The member in turn has obligations to the Society, and the Society should benefit from his membership.

Responsibilities of Member

"Our Society would make more progress toward its objectives and the individual members would benefit more from their membership, if each member understood his responsibilities and took them seriously," the LRP report stated.

It proceeded to spell out these responsibilities:

A member is responsible to support the Society in its attainment of its purpose and for his personal advancement. Specifically, he is responsible for participation in the Society's activities as follows:

(a) By attending Chapter meetings and other educational functions of the Society.

(b) By serving on Committees.

(c) By increasing his knowledge of tool and manufacturing engineering and sharing that knowledge with others for his personal benefit, the benefit of his company, and society.

Philosophy Behind Proposal

The Society's only reason-for-being is service to the member. It aims at integrating the professional, technical, vocational and even social interests of the member. The Society's leaders believe—and are confident that the 40,000-plus members will agree with them—that if ASTME is to continue its growth and development and to fulfill this role of service, it is necessary to upgrade the membership requirements.

The aim is not to *exclude*, but to *include* all those who can best benefit by membership in a mature service organization.

That is the philosophy behind the referendum vote on membership amendments.

honorary • life • **senior** • **regular** • affiliate • associate • student

2 Year Term for Board of Directors?

WHILE THE LONG RANGE Planning Committee affirmed that the general management of the Society should remain within the jurisdiction of the 15-member Board of Directors, it recommended that the tenure of individual directors be lengthened from one year to two. Such a proposal will be on the referendum ballot that goes out to the membership.

The Committee's report stated, "As the Society continues to move forward and to expand its activities, continuity of services will become mandatory." It was the consensus of the long-range planners that such continuity, along with additional stability, could best be achieved if the term of office of the directors were not so brief.

In the words of its official recommendation, the LRP group decided that "the term of office for directors should be two years with seven directors elected by the House of Delegates each year."

Mechanics Still to Be Worked Out

Final mechanics of the two-year election procedure remain to be worked out by the National Constitution and Bylaws Committee. The alternate-year schedule must take into account two conditions: first, that no additional directors above the 15 should be considered; and second, the constitutional proviso that the retiring president shall become a director for one year following his term as elected director.

The LRP report, as approved by the Board of Directors, stipulated that a candidate for director should be a Senior or Regular Member in good standing as such for at least one year. It also recommended changing the required quorum for Board of Directors actions from a majority to two-thirds, with actions to be passed by a simple majority of those present.

The director nomination procedure would remain as it has been, with this exception: Signatures of 75 or more qualified Society voters, rather than 20 as in the past, would be necessary for nomination of a director candidate by petition.

Addition of Specialists Rejected

The Long Range Planning Committee pondered the value of adding specialists, such as attorneys, bankers and economists, to the present Board of Directors.

"Although in certain instances such individuals might contribute to specific problem solutions," the LRP report conceded, "it is the opinion of this committee that the Society has sufficient contacts who can be called upon to solve particular problems as they arise."

However, the committee declared, consideration should be given to the establishment of an Honorary Board, separate from the regular elected Board of Directors.

The long-range planners reaffirmed that the Board of Directors "shall have complete charge and control of the entire property of the Society, and its decision in matters relative to such property shall be final."

The committee also reiterated the validity of the Constitution's words under Article XI, that the directors should, in managing the business affairs and property of the Corporation, "give the attention and exercise the vigilance, diligence, care and skill that prudent men use in like or similar circumstances."

The board is empowered to meet at such places as the majority of directors determine.

The Facts of Voting

EVERY VOTING MEMBER of the Society will soon be faced with a weighty decision—to accept or reject the constitutional changes recently proposed by the Long-Range Planning Committee.

The weight of this decision, however, will be far from burdensome poundage. It stems, rather, from the seriousness of the matter to be decided and the importance of the member's right to have his say in the decision-making.

How Many and What Changes Will Be Voted On?

In the near future, the voting membership of ASTME will receive a referendum ballot proposing changes in 13 of the 28 articles of the Society's constitution. To help the member cast an informed vote on these proposals, the most significant amendments—changing the membership qualifications and lengthening the term of the national directors—are discussed in detail on Pages 123 and 125, respectively, in this issue of the magazine. Also, the Long-Range Planning Report is presented on the green pages of this section.

Who Will Vote?

The following categories of membership have voting rights in a Society-wide referendum: senior, junior, life and certain honorary members who were previously senior members; and affiliate member representatives.

What Is The Voting Procedure?

The voting process for the individual member—indicating his "yea" or "nay" on the referendum ballot and returning it to the General Manager at Headquarters—is physically a simple matter. But the entire process of amending the constitution is a lengthy procedure. . .

The constitutional changes are first set forth in petitions, which in turn are circulated among the membership. When at least one percent of the Society's voting members have signed these petitions, they are turned over to the National Constitution and Bylaws Committee for review and proper presentation. The National C&B Committee then sends notice of the proposed amendments—plus full information on the reasons for and purpose of the constitutional changes—to the chairmen of all chapter C&B committees,

Within 30 days the chapter C&B committees approve or disapprove the amendments as submitted to them. If a majority of the committee approve, a referendum ballot is mailed to each voting member of the Society within 30 days. In 30 more days—from the date of the mailing—the returned ballots are counted and the result of the vote is announced by the national secretary. A majority of the votes cast determines the result. If the amendments have won adoption, they take effect immediately.

Why Vote?

Every member, by the very fact of his membership in the Society, has requested and obtained the privilege of voting, the duty to vote and the responsibility of voting wisely. The fulfillment of these by the individual member is the strength of ASTME.

1975

a report.....

LONG RANGE PLANNING COMMITTEE

1960

Long Range Planning Committee Members

GEORGE A. GOODWIN *(deceased)*	Chairman	Chapter 18	Dayton
G. BEN BERLIEN		Chapter 28	Golden Gate
IRVING H. BUCK		Chapter 51	North Texas
ARTHUR CERVENKA		Chapter 88	Long Island
CECIL E. CHAPMAN		Chapter 112	Calumet Area
HAROLD E. COLLINS		Chapter 29	Houston
WAYNE EWING		Chapter 27	Los Angeles
BRUCE FAIRGRIEVE		Chapter 26	Toronto
FRANK F. FORD		Chapter 61	Atlanta
H. VERNE LOEPPERT		Chapter 5	Chicago
H. DALE LONG		Chapter 5	Chicago
PHILIP R. MARSILIUS		Chapter 6	Fairfield County
WILLIAM MORELAND		Chapter 135	Mansfield
WILFRED J. PENDER		Chapter 53	Little Rhody
JOSEPH L. PETZ		Chapter 74	Mid-Hudson
DAVID A. SCHROM		Chapter 22	York
DEAN F. SAURENMAN		Chapter 29	Houston
LESLIE C. SEAGER		Chapter 85	Salt Lake City
FRANCIS J. SEHN		Chapter 1	Detroit
CHARLES M. SMILLIE		Chapter 1	Detroit

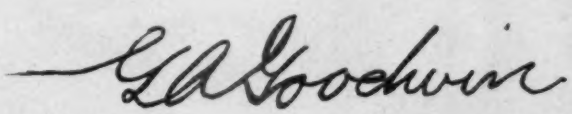
PREFACE

Many of us who have had a hand in the accomplishments of the Society during its formative years have also shared the headaches, heartaches, joys and satisfactions which have accompanied its development. With time one tends to take the progress of these years for granted.

Recalling how difficult it is to think today in terms of our past, many of us find it even more difficult or virtually impossible to visualize the future. It is fundamental that future technological developments will exceed our wildest dreams. They will encompass new disciplines of science and engineering for us to explore, and new processes and products to develop to add to our comfort, happiness and well-being.

We, as a Society, must recognize our responsibility to mankind. The Committee hopes that the following report will serve as a guide in accepting that responsibility. Future Boards of Directors will certainly have headaches and heartaches as our contemporaries have had in the last three decades.

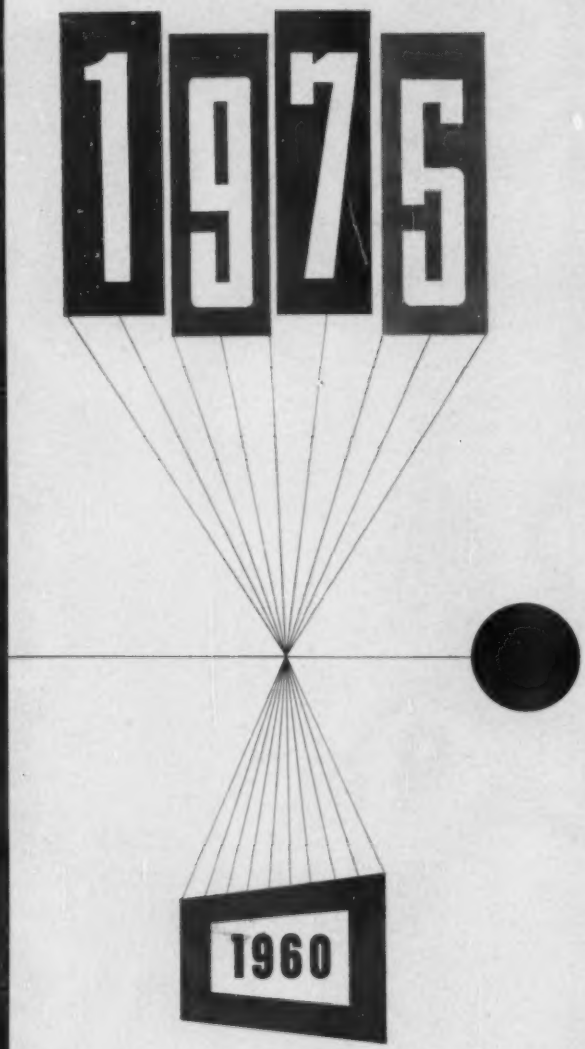
It is our hope that the Society will continue to contribute to a greater, stronger and happier America and to the improvement of man's lot in all the corners of the world. We, the Committee, collectively and individually envy you in your opportunities and know that you will meet the challenge.



(deceased)

George A. Goodwin, Chairman
Long Range Planning Committee

Dayton, Ohio
November 15, 1960



I. Purpose

The Society has from its inception had a nucleus of leaders who have been deeply interested in its long-term goals and objectives. More recently the task of studying major Society trends and activities has fallen to a similar group, known as the Progress Committee.

In all sectors of the economy, forward looking management is today carrying out what is known as formal long-range planning. This combines a time element and statistical questions of many types with resolutions of basic organizational philosophy of the institution desiring to achieve such planning. Successful long-range planning is designed to elevate the aspirations of an organization. Additionally, it should result in a team effort toward concrete goals which will lead to the attainment of the organization's basic objective.

In line with these developments, the Society's Board of Directors concluded that such a program should be initiated by the Society. The Society was, in their opinion, at the critical point in its life. If it were to continue its dynamic development, it would be necessary to look objectively into the past, at the present and toward the future, and to chart a course for the further development and refinement of the institution.

Thus, in late 1958 a new body named the Long Range Planning Committee consisting of Officers, Directors, Directors-elect and other specialists was formulated to accomplish this end. Superseding the Progress Committee, it absorbed all of the former assignments of that group. In addition, its scope was expanded to encompass a review of all facets of the Society.

II. Procedure

Since its establishment in late 1958, the Long Range Planning Committee has held nine meetings. In the course of these nine meetings, the organization's structure, functions, purposes and methods have been investigated objectively by the Committee. This investigation included a study of every operation of the Society in relation to over-all Society activity. Additionally, consideration was given to similar activities of other societies, educational institutions, government and industry.

In each instance the study of a particular activity went through three stages. These were: a historical review, a performance evaluation and a future course of action. The historical review encompassed all Society activities for the past 15 years. Based upon this review, each activity was evaluated on the basis of performance and accomplishment as related to the emphasis given and energy expended. Following the historical review and the evaluation, consideration was given to the future role of that particular activity in the continued development and growth of the Society.

Each component of 21 areas of investigation was studied in the three stages outlined above. With these factors as background the Committee categorized the organization's structure, functions and purposes into two classes. One group included all of the desirable practices, philosophies and traditions which ASTME presently has. The other included those activities which would in the future need additional emphasis, deceleration or elimination if the Society was to adapt itself to the changing and growing needs of the membership. The report which follows deals predominantly with this latter group.

III. Introduction

In the report which follows, there are many detailed recommendations. These are made with the hope that they will permit the Society to have a better future and to grow in scope as well as size as it moves toward its objective. The Committee believes that this objective, upon which the Society was founded and toward which it has been directed in the past 28 years, should not be altered in the next 15.

3.1—It is our sincere hope that in 1975 the major objective of the Society will continue to be the establishment of the Society as the leading engineering and technical service organization in the field of manufacturing.

This can only be accomplished through service to the membership of the Society to the fullest extent within the bounds of our Constitution. In so doing, the Society will serve industry and mankind throughout the world.

The Committee does not recommend hasty action toward changing the present makeup of the Society. We have a good Constitution. It is a tribute to those who have preceded us. Changes therein should be resisted except as they become mandatory or dictated by changing times and conditions. The recommended actions for changes in the Society's Constitution have been made with the above precepts in mind.

Future Boards of Directors will have the responsibility of establishing the short-term goals which will permit the Society to attain its major objective. They will undoubtedly revise and modify present programs in the future, shifting emphasis to fit the need. Flexibility, then, becomes the watchword. The addition to the name of the Society resulting from the deliberations of this Committee and the action of the Board of Directors and the membership will provide the framework for this flexibility. This alone, however, is not enough. Flexibility must be combined with continuity of service and programs if we are to succeed.

The Committee has, as a result of its studies, projected 300 chapters and 70,000 membership by 1975. It is concluded that this growth will come by providing the services through which the individual member may advance in the field of manufacturing technology. Thus, the Committee recommends that future emphasis of the Society's activities be directed toward this end. In view of this, it is the opinion of the Committee that the Society should assume the role of a central clearinghouse, combining documented knowledge of scientific and technical developments in the field of manufacturing with existing undocumented manufacturing know-how already available in the Society. Immediate steps must be taken if this projection is to be accommodated.

3.2—Specifically, the Committee is recommending, as a point of departure, the establishment of three secondary goals designed to provide for the development, collection and dissemination of information on a scale commensurate with the major Society objective. These are as follows:

3.2.1—An acceleration and expansion of the broad educational activities of the Society to provide for the development, collection and dissemination of information through those means presently available, such as books, periodicals and programs and such additional techniques and methods as may be required.

3.2.2—The expansion and refinement of the present organizational structure of the Society to parallel the accomplishment of this program.

3.2.3—The immediate initiation of an ASTME center development with facilities to house the present Society activities and with the capability of being expanded as additional requirements are developed.

As a corollary to these three recommendations, **it is further recommended that:**

3.3.1—A subcommittee be appointed to develop an over-all financial plan to provide the money and resources to accomplish these goals.

3.3.2—A permanent group similar to the Long Range Planning Committee be established to meet annually to objectively review the results being obtained and to propose re-orientation of the programs as necessary to attain the Society's objective.

This latter group should have a composition similar to the former Progress Committee. Prior to the Annual Meeting, the Headquarters staff should prepare a study outline, similar in format to the Long Range Planning Committee review material, covering all aspects of the Society's programs carried out in the preceding year. The group's review of these activities should result in recommendations to the incumbent Board of Directors for action.

Detailed recommendations for attainment of the above goals follow. The conclusions and recommendations represent the unanimous thinking of the Committee. Some of these should receive immediate action; others, although desirable, will of necessity await future consideration.

The implementation of those recommendations requiring immediate action will necessitate further detailed study. It is the belief of the Committee that such detailed planning can be accomplished more readily and more effectively by smaller groups. Thus, in the report that follows, subcommittees have been recommended when appropriate. The Committee is of the opinion that these subcommitees should be composed of members of the present Long Range Planning Committee.

The report which follows represents the major policy format within which these subcommittees should operate. It is also the hope of the Long Range Planning Committee that the report will provide a basic framework for the guidance of present and future Boards of Directors in administering the Society tomorrow.

IV. Conclusions Leading to Recommendations

4.1—Society Purposes

The American Society of Tool and Manufacturing Engineers has now been in existence for nearly 28 years. Changes have taken place in the world since 1932, our founding year. So, too, have changes taken place within ASTME. Some subtle, some less subtle. Unlike the world, changes in ASTME have at no time been drastic but the effects have been cumulative. The Society has had a remarkable growth, many successes, and undoubtedly some reverses, but the foresight of the founders of the Society has proven to be unusually keen.

The purpose of the Society as established in the Constitution is indicative of this. Inherently, it is excellent as stated; however, it is the opinion of the Committee that it should be refined to more adequately express the purpose as it applies today.

4.4.1—It is recommended that the purpose of the Society as it was written in the Constitution be changed to read as follows:

Article II—Purpose:

"This Society shall be an operating institution for the advancement of scientific knowledge in the field of tool and manufacturing engineering; shall provide the means and methods of applying such knowledge in practice and in education; shall promote and engage actively in research, writing, publishing and dissemination of knowledge within said field."

4.1.2—It is further recommended that the entire Section 2 of Article II, be moved to Article III, Articles of Incorporation, as Section 4, and that it be revised to read:

> "If there should be any net earnings from any activities, the same shall accrue solely to said institution and no part shall inure to any member."

4.1.3—It is further recommended that within the framework of the purpose as outlined in the Constitution the Society endeavor to work toward the accomplishment of the six following elements:

> a. To provide a comprehensive training program geared to the wishes and requirements of our membership.
> b. To develop a vigorous organization of local sectional activity and participation.
>
> c. To develop a vital publications program.
>
> d. To cultivate friendly relations with engineering and technical educators.
>
> e. To provide a valuable service to industry.
>
> f. To maintain a cooperative attitude in dealing with other societies that may have overlapping memberships.

4.2—Membership

4.2.1—Characteristics

The typical ASTME member is usually employed in industry and rarely is an independent practitioner. He is a highly essential star employee who participates continually in recommendations in the judgment area of management. He joins the Society primarily to improve his own technical competence with the hope of becoming a more valuable employee and thereby improve his employment status and his own economic welfare. He is primarily a technical man and not a professional man in his instincts. However, he is vitally interested in improving his technical skill and educational attainment. Although he is interested in the prestige accruing from his membership in the Society, this is not considered to be his primary reason for being a member.

Membership in the Society provides varied opportunities for the member to associate with others of similar professional and technical interests. The Society's programs integrate the social, vocational, professional and technical interests of the member. Through its technical services, it provides media for the exchange of technical experiences and assists in individual self-improvement of the members in their technical craft.

The foregoing is not to imply that membership in the Society is a one-way street; the member in turn has an obligation to the society. It is the belief of the Commitee, that the responsibilities of the individual member are not adequately visualized and spelled out and the following additional responsibilities should be recognized and enunciated.

A person who becomes a member of an organization assumes the implied responsibility of supporting the Society in the attainment of its stated purpose. Unfortunately, a great deal of misunderstanding occurs, and frequently a complete failure of communications results when responsibilities are only implied.

Our Society would have more progress toward its objectives and the individual members would benefit more from their membership, if each member understood his responsibilities and took them seriously.

4.2.1.1—In order to accomplish this end, the responsibilities of members should be put into writing as follows:

"Individual Responsibilities — A member is responsible to support the Society in its attainment of its purpose and for his personal advancement. Specifically, he is responsible for participation in the Society's activities as follows:

> a. By attending Chapter meetings and other educational functions of the Society.
>
> b. By serving on Committees.
>
> c. By increasing his knowledge of tool and manufacturing engineering and sharing that knowledge with others for his personal benefit, the benefit of his company, and society."

The above statement should, in the opinion of the Committee, be reproduced on both the membership application and the reverse side of the membership card.

4.2.2—Membership Requirements

The Society has at the present time seven grades of membership. These are Honorary, Life, Senior, Junior, Affiliate, Associate and Student. The membership grades and requirements of ASTME compare favorably with a num-

ber of other societies. However, it is the belief of the Committee that if the Society is to continue its growth and development and to fulfill its role, it will be necessary to upgrade the membership requirements for the future.

4.3—Senior Membership

The Committee, recognizing that over 75 percent of the Society's membership is classified under the present Senior grade requirements, has spent a great deal of time in exploring the various means of upgrading membership requirements. This Senior grade is a large segment of the membership and includes the men who have contributed greatly to the Society during its formative years. In the Committee's opinion, no action should be taken that would result in any downgrading of this group. The Committee is of the belief that the ultimate goal of upgrading the membership should be a transitional development, thus,

4.3.1—The Committee recommends that the qualification for Senior Member be revised to require a degree in science or engineering from a recognized school and/or professional registration, plus experience, or the equivalent thereof, as specified in the Constitution, and a minimum age of 30. Any Society member classified as a Senior on the date of passage of this amendment to the Constitution shall continue to hold the grade of Senior Member in the Society as long as he shall remain in good standing.

In addition, as an aid to the retention of members, any member, who has dropped his membership or who has been delinquent for a period longer than that specified in the Bylaws, upon reinstatement will be classified in that grade of membership for which he qualifies at the time of reinstatement.

As another phase of the upgrading of the over-all membership, it is further recommended that all former qualifications for Senior Member relative to experience shall be retained except:

4.3.2.—The Committeee recommends that Section (d) of the former Senior Member qualifications be eliminated.*

4.3.3—The Committee recommends that academic training in a recognized technical or engineering school be credited as a substitute for practical experience on a year for year basis.

4.4—Regular Membership

The upgrading of the Senior membership will leave a void between the classification and the present Junior grade of membership. To accommodate those individuals, **it is recommended that:**

4.4.1—A new grade of member to be called Regular Member be established. This grade shall include the former qualifications for a Junior Member and retain the rights of the former Senior Member with the following revisions:

4.4.2.—The Committee recommends that Section (d) of the former Senior Member qualifications be eliminated.*

4.4.3—The Committee recommends that academic training in a recognized technical or engineering school be credited as a substitute for practical experience on a year for year basis as applied to the Regular membership grade.

4.5—Junior Membership

In view of the recommendations of the Committee in Sections 4.3 and 4.4, it is recommended that the present grade of Junior Member be abolished. All members in that grade of membership at the time of final passage and action on this recommendation shall automatically advance to the grade of "Regular Member."

4.6—Associate Membership

The existence of this grade of membership is consistent with the aims and purposes of the Society. The requirements for this grade are adequately designated. Associate members should not be granted voting rights.

4.7—Affiliate Membership

The Affiliate membership is consistent with the aims and purposes of the Society. It is the belief of the Committee that the Affiliate membership is a desirable and useful grade. However, the Society is not taking full advantage of this classification. It should be expanded numerically not only for the financial aspects but for the value of management contacts.

The Committee believes that the terms "Industrial Manufacturing" and "Education" in Article IV, Section 6, are too definitive.

4.7.1.—Therefore, it is recommended that Article IV, Section 6, be revised as follows:

"An Affiliate member shall be a person, firm or corporation who or which at the time of application for membership is actively engaged in the field of manufacturing, is a technical institute, is an engineering school, or is a research or consulting organization.

"An Affiliate member may appoint as a representative any person who can qualify for the Senior or 'Regular Member' grade of membership, but shall have voting rights only as a member in good standing in one of these grades."

4.8—Life Membership

This grade of membership is consistent with the aims and purposes of the Society and serves a useful function. It is the opinion of the Committee that achievement and long service within a Chapter should not receive recognition through this or any other grade of membership.

4.9—Student Membership

The requirements for Student membership in the Society as expressed in Section 8, Article IV, of the Constitution are adequate as presently written.

4.10—Honorary Membership

The grade of Honorary member is consistent with the principal aims and purposes of the Society. It is the belief of the Committee that the Society should confer more Honorary memberships in order to attract top industrial and educational leaders. However, the limitation of this grade of membership to 1 percent of the total membership is satisfactory.

4.11—Membership Dues and Fees

The dues structure has been reviewed in detail with particular emphasis upon the member services provided. It is the conclusion of the Committee after this study that the individual member should be expected to support a larger percentage of the organizational operation of the Society. A dues increase appears to be in order for our membership. Such an increase would have a beneficial effect upon the total membership of the Society.

4.11.1—It is, therefore, recommended that the Board of Directors appoint a subcommittee to study the individual member's dues structure

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***Sect. (d) of the Constitution now reads as follows: "A person who has acquired a tool engineering background through five years of actual contact and is qualified to recommend correct tools and equipment for manufacturing processes."**

to bring the income from members' dues more into line with member activity expenditures of the Society.

4.12—Member Services

Services to the members of the Society can be broadly categorized into direct and indirect classifications. The direct services to the member include technical programs at chapter meetings, the annual subscription to THE TOOL AND MANUFACTURING ENGINEER, provision of the Society's publications at discount rates, registrations at seminars and meetings at reduced fees and participation in the educational activities of the Society, such as, on-campus conferences, refresher courses, etc. Indirect services to the members of ASTME are considered to be those services which are provided by the Society that benefit the tool and manufacturing engineering field, industry, education, government, or the public generally. Examples of these indirect services would include research, standards, professional development, public relations, and others.

It is the conclusion of the Committee that the direct and indirect services rendered to ASTME members are consistent with the objective and purposes of the Society.

Generally speaking, the member receives an adequate amount of service from the Society. Particularly important to the individual member are the chapter programs and meetings, THE TOOL AND MANUFACTURING ENGINEER, technical publications, and the tool expositions.

It is the opinion of the Committee that any future expansion of Society member services and programs should be in line with Society growth. These future services should be constructed to benefit both the individual and groups of members. They should be oriented for technicians generally but not to the exclusion of theoretical, scientific or professional groups. Services promoting technical knowledge should have a definite priority over services that will provide prestige only. Additional member services should, whenever possible, be established on a self-liquidating basis.

It is, therefore, recommended that:

4.12.1—Future member services be oriented generally toward the technician but not to the exclusion of the scientific and professional member.

4.12.2—Future member activities be established on a self-liquidating basis.

4.13—Technical Activities

The technical activities of the Society fall into ten major classifications. Each of these has been reviewed as outlined in the "Procedure" section of this report. It is the opinion of the Committee that the technical activities in which the Society is presently engaged are consistent with the general aims and objectives of the Society. The Committee further believes that all of the present technical activities of the Society should continue. In the detailed activity reviews which follow, recommendations are made relative to the emphasis which the Committee believes should be placed upon each of these. It naturally follows that future Boards of Directors will shift these emphases to fit the needs of the time.

Recognizing that the percentage of the total membership currently participating in and actively contributing to the technical activities of the Society is extremely low, every effort should be made to increase the individual member's participation. This should be accomplished through a combination of those activities already in existence and additional new ones designed around the recommended goals.

4.13.1—Education

Educational activities represent the primary means through which the Society can fulfill its stated purpose. It is the opinion of the Committee that the responsibility for provision of educational programs and activities which will be of prime interest to the membership should rest with the Society.

Existing educational institutions carry the individual only to a certain point. Thus, primary educational activity for the Society lies in the realm after formal schooling and in industry. To fulfill our role it will be necessary to expand our present activities into a flexible program that can be adjusted to meet the needs of tool and manufacturing for all conditions in the future. The program must be developed and refined to the point where it is recognized by *all* individuals interested in manufacturing. Success of such an undertaking demands that the activities provided fill the existing need.

The Committee is aware of the fact that most colleges and universities in this country are tending to emphasize scientific engineering curricula. At the same time, industry is still primarily interested in the individual with technical competence in specific fields. In view of this, the Committee believes that Society relationships with educational institutions should be oriented toward the engineering institute but not to the exclusion of the recognized colleges of engineering. The technical institutes and community colleges of the country, appear to be most interested in the development of the disciplines involved in tool and manufacturing engineering. They hold the greatest potential for tool and manufacturing education. Due to their dependence upon industry in many cases for material and financial support, these institutions have always been aware of the specific needs of industry.

To avoid a duplication of effort and bearing in mind the recommended realm of future Society activities, the Society should not consider the creation of any formal training facility which would result in the granting of degrees in the field of tool and manufacturing engineering. **However, it is recommended that:**

4.13.1.1—Creation of a training facility or the use of some facility possibly in existence for specialized courses in the various phases of tool and manufacturing engineering should be considered. Such specialized courses should also be considered for the establishment of in-plant training courses.

To further solidify its position, the Society should produce educational materials in the form of textbooks, reference books and audiovisual aids for education and industry.

Many industries today operate their own cooperative educational programs due to the deficiencies noted above. Some are outstanding successes. One example is the General Motors Institute. However, most companies are not large enough to underwrite or carry out such extensive programs. These organizations are particularly desirous of having some Society or organization carry out transitional training after formal schooling and in industry that prepares an individual for his industrial responsibilities. It is the opinion of the Committee, that ASTME is in an excellent position to fill this need.

4.13.1.2—Thus, it is recommended that the future educational activities of the Society should be directed toward the ASTME member and technicians and engineers who are non-college graduates. Secondary emphasis should be placed on technical institute and college students, and/or graduates, management with direct tooling responsibility and educational personnel.

4.13.1.3—The Committee further recommends that the Society's present educational activities should be accelerated. In addition, new activities should be introduced to establish the Society as the leader in its field.

In evaluating those educational activities presently being pursued by the Society, it was concluded that the least significant educational activity presently being carried out is the National scholarship program. The Committee is of the opinion that the Society has not received commensurate value for its investment to date in scholarships.

4.13.1.4—Therefore, it is recommended that the present scholarship program should be modified to include a program of grants similar to the recommendation made to the Long Range Planning Committee by the National Education Committee.

Under this proposal three classes of grants would be established ranging in value from $100 to $10,000. These would include grants for faculty research, salaries, course and curricula development, scholarships and loans to students, student project support and facilities. It is further proposed that an Educational Grants Committee be organized similar to the Research Fund Committee. The duties of this Committee as proposed would be to administer and to allocate available funds upon request of grantees. The advantages of such a committee are twofold. It is independent of political pressure and more important the committee can be composed of the ablest men available. All requests for grants would require the endorsement of the NEC before being forwarded to the Educational Grants Committee. It is believed that such a Committee would serve as a focal point and act as a trustee for handling monies for educational purposes from small and medium sized companies which would like to contribute to manufacturing education, but do not now have a suitable vehicle for making contributions.

The Committee is of the opinion that the proposed Educational Grants Committee has a great deal of merit. However, serious thought must be given to the future method of handling all grants of the Society including those made through its Research activities. It is suggested that perhaps the ideal approach to the entire problem is to have a single committee, combining the activities noted with those of the present Research Fund Committee. This committee could have jurisdiction over all Society grants and handle Society funds through an ASTME Foundation established for the purpose. Research funds could still be raised from outside sources and be held as custodial trust for the specific project involved.

4.13.1.5—In view of this, the Committee recommends that a single subcommittee be appointed to investigate the Research activities of the Society in light of the recommendations and proposals on the future educational grants program outlined.

Consideration should be given to both the Committee's expressions on educational grants and the opinions expressed relative to Research under Section 4.13.10 of this report. Discussions with the Research Fund Committee and the National Education Committee on the over-all subject would be in order.

A review of the educational activities of other societies highlighted two services not being carried out by the Society at the present time. These are correspondence courses and a central library service. Assuming the acceptance of the recommendation of the Committee for the expansion of the broad educational activities of the Society, it is recommended that the Society establish and develop these two activities.

4.13.1.6—The Committee recommends that the Society establish correspondence courses designed to appeal to the interests of the groups enumerated. The courses should be applicable to the field of tool and manufacturing engineering. Their content should be such as to provide transitional training between formal schooling and in industry. They should be comprehensive and provisions should be made for suitable recognition of the completion of such courses. In the program's initial stages such courses should be designed around the field of manufacturing technology. However, as acceptance and recognition of the Society's position in the educational community becomes established, the Society should consider the establishment of educational courses outside the general area of tool and manufacturing engineering.

4.13.1.7—It is further recommended that the Society establish a central library service of tool and manufacturing engineering literature. This service would be available upon request. It would provide, through indices maintained by staff personnel, a current bibliographical listing on all media concerning manufacturing technology. Such a service would benefit not only the membership but industry and the government as well. At the same time, the Society would indirectly receive worldwide recognition for its leadership in this area.

4.13.1.8—In conclusion, it is recommended that subcommittees be appointed to establish the means of implementing these two new programs. Their findings should result in recommendations to the Board of Directors, at the 1961 Annual Meeting. The foregoing two recommendations are considered to be only a point of departure. Additional educational programs should be considered and added to the over-all program as the need is created.

4.13.2—Technical Conferences

Technical conferences have been a basic part of the Society's activities since its founding. Since that time, they have developed gradually to a point of national recognition. From 1960 on, the technical conferences will be held annually in conjunction with the Tool Exposition and at certain semi-annual meetings of the Society.

The Committee is of the opinion that the holding of technical conferences is consistent with the aims and objectives of the Society. They provide a medium whereby the individual member may not only participate through the presentation of papers, but also attend the technical sessions as well. The conferences, as presently held, are considered to be one of the Society's most effective educational activities.

The most important contribution emerging from Society sponsorship of the technical conferences is the provision of new information and techniques to the membership. The Committee is of the opinion that this activity should continue to emphasize new developments and technology as a means for assisting the professional development of our members. It is recognized that the Society gains prestige through the holding of such events, however, this is considered to be a secondary benefit.

With the tremendous worldwide emphasis that is being placed and will continue to be placed upon technology, it is expected that demand will outrun and overtax existing conference programs. If the interests of our organization appear broad and diversified today, they will be even more diversified in the future. Not only to serve our present membership but to provide additional coverage for the anticipated expansion of that membership, ASTME's conference activity will of necessity experience a phenomenal growth rate in the next 10 to 20 years. To keep pace with the technological developments and advances will provide a challenge for the Society that is difficult to comprehend or even envision at this time. Demands of our members and industry for up-to-date information will necessitate the gradual formation of permanent divisions or sections of specialized interest within the Society. Such diversification will continue for years to come.

4.13.2.1—With these points in mind, it is recommended that the

Society consider specialized subject conferences to fulfill the need of those specialized groups which will develop naturally in the future.

4.13.2.2—It is further recommended that the technical conference activity of the Society be expanded geographically to permit the presentation of technical information to the membership in those areas not directly associated with the major exposition areas. This is held to be particularly necessary in view of the Committee's recomendation that technical conferences be dropped at semiannual meetings occurring on nonshow years. Assuming that the Society's growth will continue as projected, recognition to and the development of a worldwide conference activity will of necessity have to be considered for the future. It is fundamental that any future expansion of the conference programs should be as far as possible on a self-liquidating basis. Bearing in mind that the programs of the Society should remain flexible, no consideration should be given to the establishment of permanent conference facilities at various locations throughout the country. Although the conference activity, per se, is expected to increase tremendously, the location of such conferences should be flexible enough to fit the needs and desires of the membership and the times.

4.13.3—Technical Publications

As defined by the Committee's study, technical publications activities of the Society include the publication of books, handbooks, and similar publications. In the opinion of the Committee, the technical publications activity of the Society should be one of the outstanding methods of attaining the Society's objective. The opportunities in this area appear unlimited since the field of tool and manufacturing engineering is not adequately served by the present sources of such publications. These include private publishers, industry, educational institutions and other societies. As a result, it is the belief of the Committee that the books published by the Society provide not only a service to the membership but to industry, government and education as well.

The Society's books published to date are considered to be outstanding. All future publishing activities should strive for similar quality. In the opinion of the Committee, activities in the reference publication area on the part of the Society are only limited by ourselves. They are as open as we wish to make them.

4.13.3.1—With these considerations in mind, it is recommended that the Society's book publishing program be accelerated. It is recognized that with this acceleration, subsidization of the book program will be necessary until such time as it is possible to produce an income over expense. In this acceleration of the activity, textbooks should be given the highest priority. These books should be designed to provide transitional training between formal schooling and in industry. In conjunction with the increased emphasis on textbooks, consideration should be given to specialized books on processing, metal removal, numerical control, tool design, automation, and cost analysis. It is the opinion of the Committee that books covering these aspects of tool and manufacturing engineering are most urgently needed.

4.13.4—Periodical Publications

The periodical publishing program of the Society centers around the publication of THE TOOL AND MANUFACTURING ENGINEER. THE TOOL AND MANUFACTURING ENGINEER is one of the Society's best means of fulfilling its chartered purpose to disseminate scientific knowledge in the field of tool and manufacturing engineering. Additionally, this publication is the Society's most successful method of providing continuity to our over-all programs. It keeps the member informed with respect to Society's programs and activities as well as the activities of the various chapters. It is and should remain the official Society journal and should continue to be recognized as such throughout the world's industrial market.

As an authoritative engineering journal reporting technical and scientific developments in the field, it evaluates production problems in terms of producing the best product at the lowest cost for the best economic good.

Although in a highly competitive field, THE TOOL AND MANUFACTURING ENGINEER is considered by the Committee to be the leader of the 17 commercial and seven Society publications now serving the metalworking industries. Constant vigilance must be exercised in the coming years to maintain this position of leadership. To insure this, reviews and improvements should be made continuously.

In the opinion of the Committee, THE TOOL AND MANUFACTURING ENGINEER should continue as the Society's major periodical and no consideration should be given to the publication of an additional scientific periodical.

4.13.4.1—It is, however, recommended that the Society consider the periodical publication of abstracts of current literature in the tool and manufacturing engineering field. Such an activity could be correlated with the central library service proposed under the Education Activities section of this report. It is recognized that the publication of THE TOOL AND MANUFACTURING ENGINEER is to a great degree supported by the advertising income of that publication. The Committee is of the opinion that an excessive amount of advertising in a publication can detract from the editorial and technical content. Thus, the Committee would alert future Boards to consider the possibility of increasing the frequency of the publication when such a stage is reached.

4.13.5—Standards

The standards activities of the Society represent one of its oldest endeavors. It is an area where the Society may take a very active role for the benefit of industry and mankind in general. By its nature, standards work is a cooperative effort. As such, the Society through its standards program should be able to actively participate in the establishment of standards for the progress of the nation. Thus, standards activities afford an opportunity for members and chapters to work on such cooperative projects. In this regard it differs from many of the other technical activities of the Society which characteristically have individual appeal and application.

It is the opinion of the Committee that standards activities are consistent with the aims and objectives of the Society. The activities are believed to be significant to the individual tool and manufacturing engineer, industry, and government. With these considerations in mind:

4.13.5.1—It is recommended that the Society's standards activities should be continued at their present level. As the Society continues to grow and our ability to financially support the program increases, an acceleration commensurate with this growth should be considered. Correspondingly, as the Society's role increases internationally, we should take a more active part in international standards activities.

4.13.6—Expositions

The Tool Expositions of the Society today represent one of its most successful endeavors. They are held by many individuals outside of the Society to be the outstanding events of their kind put on in this country and for that matter the world. These expositions serve not only the membership of the Society but industry and mankind as well. They are considered to be one of the Society's primary educational activities. Thus,

their sponsorship and operation is harmonious with the general purposes and aims of the Society. The main objective of the Tool Expositions is the presentation of new ideas and developments to the membership. Through this means, the Society receives recognition by industry on an international scale and at the same time fulfills one of its obligations to the profession of tool and manufacturing engineering. It is the opinion of the Committee, that the Society's Tool Exposition activity should be increased as the need and demand for such events justify such action. Our present exposition schedule, that is, annually with the West Coast exposition on alternate years, should be adequately tested prior to any consideration of future expansion of this activity.

4.13.6.1—It is recommended that when such expansion is justified, the Board of Directors at that time should consider the establishment of regional expositions of comparable size to our West Coast exposition. The Committee is of the opinion that such additional expositions should be held in other selected areas similar to Los Angeles on the odd years in conjunction with the semiannual meetings.

The exposition program should continue to emphasize the quality and prestige already established for this activity. It should retain its present flexibility permitting the encompassment of all new developments in the field of tool and manufacturing engineering. The objective of this activity should be to obtain unchallenged recognition as the top exposition in its field, thereby increasing ASTME's service to members, to tool and manufacturing engineering, and to industry.

4.13.7—Professional Development

The National Professional Development activity was established by the Society in 1952. The activity's primary purpose is to encourage the professional growth of the tool and manufacturing engineer whether he becomes registered or not. It has the secondary function of maintaining liaison with the various registration agencies to promote the recognition of the profession of tool and manufacturing engineering and to keep abreast of registration laws and their effects upon the membership.

The Long Range Planning Committee recognizes that laws pertaining to the registration of engineers exist in nearly all states and countries. The Committee also realizes that the major effort to encourage professional registration of engineers has been left to engineering societies. The degree of the acceptance of this responsibility varies greatly. Some, such as the National Society of Professional Engineers and the American Chemical Society, carry on highly organized programs. There are others, at the same time, such as the Society of Automotive Engineers and the American Institute of Industrial Engineers, and the American Society for Metals, who are unable or unwilling to engage in any organized program. The Society's activities in this area are for the most part considered to be comparable to those of the moderately active societies.

4.13.7.1—It is the recommendation of the committee that the professional development activities of ASTME should be maintained at their present level and rate. The Committee is of the belief that the Society's efforts in the area of professional development should continue to emphasize and encourage the professional growth of tool and manufacturing engineers. Registration should only be on a voluntary basis for those engineers who so desire and at no time should it become a prerequisite for membership in the Society.

As a future course of action, the activity should encourage professional growth on the part of members who are qualified but not registered, on the part of those members who are not qualified but have the potential to become so, and last but not least those members who will in all probability never be qualified. To accomplish this three-phase program:

4.13.7.2—It is recommended that the Professional Development Committee and the Education Committee of the Society should begin active cooperation in those areas involving the educational advancement of the membership.

4.13.8—Information Services

The purpose of this activity is to furnish information on the field of tool and manufacturing engineering and the Society, together with its technical or semi-technical implications, to members, industry, education, government and the public. This activity is under the guidance of the National Public Relations Committee. In the opinion of the Long Range Planning Committee, the operation of an Information Service by the Society is consistent with the aims and objectives of the Society. It is recognized that this activity is highly related to all other technical activities of the Society. In fact, their success is in many instances dependent upon the endeavors of this organization. Hence, no genuine separation can be made.

The Comimttee believes that the results of this activity to date have been reasonably effective. However, present Society activities are directed too much toward our own members with insufficient emphasis placed upon manufacturing executives and management at the National level.

Ideally, this activity should provide a planned promotion program designed to establish ASTME in the public mind (i.e., membership, industry, education, government, etc.) as an institution of character which functions in the public interest. Thus, the direction of this function should be oriented primarily toward the National level. In its future endeavors, the complete range of communications methods and media should be utilized toward this end.

4.13.8.1—The Committee, therefore, recommends that future Information Services activities of the Society should be concentrated upon the portrayal of the role of the tool and manufacturing engineer and the Society's part in his development to the membership, industry, education and the government on a National basis.

4.13.9—Honor Awards

This activity is under the guidance of the National Honor Awards Committee. The purpose is to inspire a high endeavor in the immediate and related fields of tool and manufacturing engineering through the granting of suitable awards. The activity as presently constituted is considered by the Long Range Planning Committee to be adequate and consistent with the over-all aims of the Society. It is recognized that the awards must of necessity be limited in number and high in value (nonmonetary) to the recipient.

4.13.9.1—However, it is recommended that as the Society continues to expand in size and in activities, it should consider the following additional awards in the future:

4.13.9.1.1—An award for the best paper presented at an ASTME Annual Meeting.

4.13.9.1.2—An award for the best paper published in THE TOOL AND MANUFACTURING ENGINEER magazine during a one-year period.

4.13.9.1.3—Awards designed for a specific area of tool and manufacturing engineering such as, processing, planning, methods, tool design, etc.

4.13.10—Research

The Board of Directors action and amendment to Constitution in 1952 es-

tablishing the ASTME Research Fund is considered by the Committee to have been an outstanding advancement for the Society. There is no question but what ASTME should have a Research Fund and thereby participate in research in tool and manufacturing engineering. Article XIX of the Constitution with regard to the Research Fund Committee is satisfactory as written with the exception of Sec. 2.

4.13.10.1—The Committee recommends that Sec. 2 of Article XIX be revised to read: "The purpose of this Committee is to administer research for the advancement of scientific knowledge in the field of tool and manufacturing engineering, in such manner as will promote general prosperity, welfare and security."

Shortly after its conception in 1952, the Research Fund Committee was faced with the question of what type of research was its proper field. Basic research, while essential in any field, is by far the least popular. This is so because it adds to the fundamental knowledge on which all advance is based. It seldom solves today's perplexing problems. Rarely is it reflected in the profits of a company. It was also clearly evident to the Research Fund Committee that development and applied types of research were being carried out to varying degrees in certain fields by industry, government and educational institutions.

The question then, as today, is one of determining where the responsibility lies for the carrying out of the different types of research in tool and manufacturing engineering. After considering all factors, the Long Range Planning Committee is of the opinion that there is a definite need for all types of research whether basic, applied or developmental in the field of tool and manufacturing engineering. The Long Range Planning Committee has dealt with this issue and the related problems involved at great length.

Basic research in this field is believed to lie more in the realm of the government than the domain of technical societies. Most developmental research in our area is being carried out by industry primarily and governmental agencies secondarily. Thus, the Society's natural realm appears to be applied research which will benefit the largest sectors of mankind and the national economy.

4.13.10.2—It is, therefore, recommended that future Society-sponsored research projects should primarily be in the applied fields of tool and manufacturing engineering that will provide the greatest good for the largest sectors of mankind.

Recognizing the Society's role in the promotion of research in the field of tool and manufacturing engineering, the Committee has reviewed the problems of future funding of the program in detail. The advantages for the Society resulting from sole Society financial support have been weighed against the advantages and disadvantages of funding from other sources. The outstanding advantage of Society sponsorship is that the research activity being carried out is entirely under the control of the Research Fund Committee without consideration of outside influences. The major disadvantage lies in the fact that the amount of research work that can be undertaken is limited by the funds furnished by the Society. It is axiomatic that such activity is contingent upon the Society's ability to raise funds through its various activities. Regrettably this makes the flow of such funds unpredictable and hence the scheduling of research work difficult. It is recognized that when support is provided from outside sources, the scope of the individual projects can be greatly expanded. However, the Society immediately loses the major advantages of sole Society support listed.

Thus, we see funding of the future research activities of the Society as the major problem facing this activity. The Committee is of the opinion that in spite of the disadvantages, it is preferable that research funds should be obtained from outside sources and that the ideal method of handling the research activities of the Society in the future would be for the Society to pay administrative costs with outside sources funding the projects monies. Industry appears to be the best source for such funds. The raising of funds from these outside sources for ASTME's research activities should be the responsibility of both the Committee and the Society. In reality it is recognized that to maintain its position as a sponsor of research, the Society will of necessity have to actively support the program both administratively and financially until a definite program is established. The Committee is, however, of the opinion that future appropriations for research activities should only be made from current income of the Society. Thus, the amount of support in any given year must remain flexible and be predicated upon our ability to pay.

Serious consideration must be given to the degree of the Society's future role in the sponsorship and support of research.

4.13.10.3—It is, therefore, recommended that the future course of the Society's Research activities be reviewed by the subcommittee established in recommendation 4.13.1.5 of this report.

In its deliberations, the Committee has thoroughly considered and evaluated the establishment of research facilities under the sponsorship and guidance of the Society.

4.13.10.4—It is the recommendation of the Committee that the establishment of facilities for the conducting of research should not be considered by the Society in the future.

Research projects should continue to be placed among the leading public and private institutions of learning and research as in the past with the Society's role being that of a coordinator or sponsor.

4.14—Organization

In its 28 years of existence, the Society has developed into an outstanding institution. It is today a highly organized functioning body designed around the requirements and manifestations of the individual member. As previously noted, the Long Range Planning Committee is deeply cognizant of the individual member and his role in the establishment and continuation of the institution. It then becomes the obligation of the Society to provide the organizational structure which embodies this general principle. The fundamental responsibility of the organization which results is to provide the individual member with the opportunities to associate with others of like social background and similar professional and vocational aspirations. It is the opinion of the Committee that the present organizational structure of the Society permits the accomplishment of this at the present time. However, as in the past, new and changing conditions will necessitate future changes in the organization so that it might best serve the conditions in any given period.

With these precepts in mind, the Committee has reviewed all aspects of the organizational structure of the Society in detail. The results of this review fall into seven major categories which follow.

4.14.1—Chapters

The Society has followed the normal growth pattern of most similar organizations. Initially local in nature, the Society expanded both numerically and geographically. During the development process and as the central admin-

istration of the Society became increasingly remote, the need and value of the local grass-root developments increased. This has continued to the point where the chapter stands today as the most effective unit for carrying out the purposes of the Society. Herein lies our strength. Chapters should, in the opinion of the Committee, guard jealously their individual prerogatives within the institution. Recognizing that a chapter's effectiveness is directly proportional to the calibre of its leadership, the Committee believes that the National organization should encourage and motivate the individual chapters to select outstanding men for their leadership. The training of these outstanding leaders in how to effectively run the Chapter unit becomes one of the prime responsibilities of the National organization.

The Long Range Planning Committee is of the opinion that the chapter will continue to be the leading Society operation at the local level.

4.14.1.1—It is therefore recommended that the National organization orient pertinent group activities of the Society toward the chapter in the future.

With this in mind, it is suggested that steps be taken to establish procedures designed to develop closer cooperation between National and Chapters. Such procedures should provide assistance for the chapter chairman beyond the concepts of the Leadership Conference. These could include such devices as a monthly calendar to assist the chapter chairman in the operation of his chapter. In line with this, it is suggested that a simplified monthly report for submission to Headquarters encompassing meeting minutes, attendance data, program, etc., be established to eliminate unnecessary duplication and to simplify the over-all job of the chapter leaders.

While recognizing the necessity for closer cooperation and ties between chapters and the National Headquarters, the Committee wishes to point out that a reciprocal relationship is involved. Certain reports from the chapters are required by Headquarters to comply with the legal aspects of the Society's operations. Some chapters have been remiss in the past in the forwarding of these reports.

4.14.1.2—In view of this the Committee recommends that in the future monthly allocation checks currently due to chapters should be forwarded contingent upon receipt of specified reports at Headquarters.

The Committee is also of the opinion that a chapter can be too large to benefit the individual member. This is evidenced by the fact that the attendance percentages of chapter meetings and programs decline directly with an increase in the number of members in a given chapter. Although the effectiveness of a chapter appears to drop off with increased size, no maximum number of members should be established. However, in such instances it is suggested that an effort be made to have the local membership establish an additional chapter within the area.

4.14.1.3—The Committee recommends that the 75-member requirement for the formation of a new chapter be interpreted to mean 75 new or transfer members.

It is to be emphasized, however, that National should take no active part in any such diversification.

In line with their studies of the chapter and its relationship to over-all Society operation, the Committee has fully discussed off-shore chapters and their role in the future of the Society.

4.14.1.4—The Committee recommends that ASTME shall continue to operate basically in the same manner as today, that is, to have North American chapters and off-shore chapters. North American chapters will include any future chapters chartered in Alaska or Hawaii or any other State or Province. It is further recommended that the Society shall not charter off-shore student chapters.

The Committee further recommends:

4.14.1.5—Off-shore chapters shall be entitled to the same representation in the House of Delegates, membership on the Board of Directors and election to the Officer group, as North American chapters. This recommendation is made with the qualification that in the event expenses are paid, they will only be paid from the nearest coastal port of entry on the mainland.

4.14.1.6—All chapters, both North American and off-shore, shall be individually entitled to full use of proxy vote.

4.14.1.7—All grades of membership shall be the same for both North American and off-shore chapters.

4.14.1.8—As the Society continues to expand its off-shore activities, the additional operational expenses (i.e., costs beyond normal North American chapter service cost) incurred in servicing these members and chapters should be borne by them.

4.14.1.9—In the event shows, seminars, conferences and similar activities are requested by off-shore chapters and approved, they must be operated on a self-supporting basis.

4.14.1.10—That a staff member be assigned in the near future, part-time or full-time as deemed necessary, to coordinate the operation of off-shore chapters. It is the opinion of the Committee that all details such as communication, mailing, rates of exchange, etc., should be coordinated by this individual.

4.14.2—Regional Councils

In the course of their reviews and studies of over-all Society operations and the chapter activities in particular, the Committee has fully studied the regional council movement in the Society. It is the Committee's opinion that regional councils will continue to expand. Although a few councils might have been organized for political reasons, today their primary purpose is that of improvement of their operations.

The Committee is of the opinion that the regional movement should not be formalized. The purpose of our Society is to advance the knowledge and practice of manufacturing technology to our members and through our members to society. We cannot do that as effectively in the thinking of the Committee from a top down basis as we can from the thinking of the total membership from the bottom up.

4.14.2.1—Hence, the Committee recommends that the regional councils should only be encouraged on an informal basis to work toward the solution of mutual problems. The boundaries of such regions should be established by mutual agreement of those in the areas served. Rules and procedures of such area or regional groups must not conflict with the Constitution and Bylaws of the American Society of Tool and Manufacturing Engineers.

4.14.2.2—With this in mind, it is recommended that minutes of meetings of the area and regional councils must be submitted to the National Secretary in accordance with Section IV of Chapter Procedures, which states: "According to Corporation laws of the State of Michigan, properly signed and countersigned official minutes of all National Chapter Membership, and Executive Committee Meetings, must be kept in the corporate records at National Headquarters."

The minutes of the council meetings

should be received and filed at Headquarters in accordance with Article X, Section 1, of the Bylaws. Therefore, no revision of the National organization will be necessary as a result of the regional council movement.

4.14.3—House of Delegates

The Committee has reviewed the functions, purposes and representation of the House of Delegates. It is the opinion of the Committee that the existence of the House of Delegates is consistent with the Society's aims and that the concept of the House of Delegates is sound. It is believed to be the most effective means available of representing the wishes of the membership.

The Committee is of the opinion that the power and the governmental position of the House of Delegates should remain substantially the same in the future. It should be limited to discussion and recommendation (other than elections) on the affairs affecting the welfare of the organization. The House of Delegates should continue to elect the Board of Directors and meet in closed sessions.

4.14.3.1—The Committee recommends that the title National Delegate be retained and that the Delegate should be the incoming Chapter Chairman and the Alternate should be the incoming First Vice Chairman as long as a form of Leadership Conference remains an annual event.

4.14.3.2—It further recommends that a single Delegate-at-Large shall represent all members-at-large regardless of the number of members in this category in the future. However, to more effectively represent the members-at-large, the Delegate-at-Large and an Alternate Delegate-at-Large shall be elected by the House of Delegates at the Annual Meeting one year prior to the meeting at which he shall be entitled to vote.

4.14.4—Officers

The Committee has reviewed in detail each of the National Officer positions. It is the consensus of the Committee that the Society has a correct array of Officer positions for carrying out the Society's objectives. The nomination and election procedures for Officers are satisfactory as writen and consistent with the principles of the Society. No change should be made in the present eligibility requirements for Officers. The duties of each officer are adequately enunciated and there are no important omissions.

4.14.4.1—The Committee recommends that the term of office for Officers remain as written and that no definite procedure be established to assure orderly progression through the chairs to the Office of President.

4.14.5—Directors

The Board of Directors is the governing body of the Society. It is the opinion of the Committee that the general management of the Society should continue to lie with the Board of Directors. The duties of the Board of Directors as cited in Society law and as being carried out at the present time parallel the usual practice and procedures of the American industry.

The Board of Directors as established under the Constitution has in the opinion of the Committee contributed greatly to the advancement of the Society. It is the consensus of the Committee that certain revisions in the term of office and procedures should be made to more adequately provide for continuity in the Board's role as the management group of the Society. As the Society continues to move forward and to expand its activities, continuity of services will become mandatory. The Long Range Planning Committee believes the present term of office does not provide the necessary continuity.

4.14.5.1—Thus, the Committee recommends that the term of office for Directors should be two years with seven Directors elected by the House of Delegates each year.

It is the opinion of the Committee that this staggered basis of election will provide for much greater continuity and stability.

No additional Directors should be considered. The requirements of eligibility and the present system of arriving at nominations for the Board of Directors should continue.

4.14.5.2—In addition, it is recommended that the required quorum for Board of Directors actions should be two-thirds of the Board of Directors with actions to be passed by simple majority of those present.

The Committee has considered the value of the addition of certain top specialists from fields such as banking, law, etc., to the present Board of Directors. Although in certain instances such individuals might contribute to specific problem solutions, it is the opinion of the Committee that the Society has sufficient contacts who can be called upon to solve particular problems as they arise. During the course of these discussions, it was, however, the consensus of the Committee that consideration should be given to the establishment of an Honorary Board, separate and distinct from the Board of Directors.

4.14.6—Committees

The Committee has examined the Society's over-all committee structure and each administrative committee in detail. The evaluation was carried out with the underlying philosophy of greater member participation in mind. As a result of this study and evaluation, the Long Range Planning Committee is of the opinion that the committee system of conducting the Society's business and technical affairs can be one of the Society's greatest assets.

The Committee believes that our Society's future growth and strength will come through service to the individual member. In order to accomplish this end, the Committee feels that it is very important to keep in close contact with the grass-roots membership by a continuous influx of the new blood from the men graduating each year from the Chapter Chairman's responsibility.

4.14.6.1—It is, therefore, recommended by the Committee, that one-third of the members of national committees should be replaced each year. For those committee members whose performance is appraised in the lowest one-third by the committee chairman, one year is recommended. For those committee members whose performance is appraised in the higher two-thirds of the committee, reappointment is recommended. The top two men on the committee should be considered for Vice Chairmen, and the Vice Chairman whose performance is best should be recommended for committee chairman. However, it should be possible for the vice chairman to serve two terms. It is the belief of the Committee that this guide can provide the desirable participation noted.

In line with these suggestions, the Long Range Planning Committee is of the opinion that continuing in service for additional terms should only apply to those members whose performance warrants it. Four appraisal forms designed by the Long Range Planning Committee [appended to the report as presented to the Board of Directors] are suggested for appraising the performance of the Officers, Board of Directors, the committee chairmen and committee members. Appraisal factors were discussed at length by the Long Range Planning Committee and the factors reflected on the forms are those judged by the Committee as most im-

portant. Ratings are excellent, good, and fair with point values of three, two and one, respectively. The Officers and Board of Directors should be appraised by the National President who is also Chairman of the Board of Directors. The committee chairmen should be appraised by the Vice President to whom the committees are assigned, and the committee members should be appraised by the chairman of each committee.

Every person serving the Society whose performance will be appraised at the end of his term should be so informed and a blank copy of the appraisal form should be given to him so he will know the factors that he is being appraised on. The primary purpose of appraisals is to secure more effective performance and to insure the growth of the Society through the service and guidance of the most outstanding men. The appraisals of the Officers should be submitted to the Officer Nominating Committee. Appraisal of the members of the Board of Directors should be turned over to the Annual Nominating Committee for their guidance in selecting the top two-thirds of the non-officer Board members to be nominated for the ensuing year.

During the course of their studies, the Long Range Planning Committee concluded that the over-all committee structure of the Society, as it now exists, needs serious review. Certain committees should be strengthened, others should be reduced, and some eliminated entirely. In view of the importance of committee activity in the fulfillment of the Society's purpose and in providing greater opportunity for member participation:

4.14.6.2—It is recommended that the Board of Directors appoint a subcommittee to review all aspects of Society committee activity and to report their findings to the Board of Directors at the 1961 Annual Meeting. The scope of this committee should include a detailed analysis of each national committee and that committee's contribution to the whole of the National operation. Upon completion of this review, it is hoped that the committee will submit recommendations relative to the degree of emphasis that should be placed upon each committee in the future.

4.14.6.3—The Long Range Planning Committee recommends that the following decisions of the Committee relative to committee operations be submitted to the subcommittee as a guide for their deliberations:

4.14.6.3.1—Since travel is the largest single budgetary consideration of committees, travel of committee members should be reviewed most closely. It is suggested that a central committee meeting location controlled by the geographic composition of the committee should be established annually to eliminate extraneous travel. Such a ruling should hold for all committees except the Host Committee meetings of the Program Committee. Further, the number of committee meetings held annually should vary with the composition and business of the committee.

4.14.6.3.2—Serious consideration should be given to the number of committee members required for each activity. It is the opinion of the Committee that some of the committees as they are now operating have too many members. The Committee feels that in many instances they can operate with fewer members.

4.14.6.3.3—No change should be made in the term of appointment or election of committee members.

It is the belief of the Committee that the policies suggested will benefit the Society and aid in the providing of continuity which is so essential to our programs for Society advancement.

4.14.7—Headquarters

Ample recognition has been given throughout this report to the growth and expansion of the Society to date and its anticipated development in the coming decades. Paralleling this expansion and in no small part responsible for it, has been the growth of the Headquarters staff and facility. In the early days of the Society much of the work involved in the activity programs of the Society was carried out by members and part-time workers. Since that time, we have witnessed the development of a diverse, complex and specialized service organization centered in the National Headquarters. Through this group, the Society's programs are coordinated and carried out. The Society has been particularly fortunate in its selection of specialists for its staff organization. These individuals, in conjunction with the Society's Officers, Directors and Committees, have provided the ways and means for this growth and development.

The Headquarters organization has developed and expanded to fit the Society's needs as they have grown. Since the early days of the Society, the administration of the Headquarters staff has been under the direction of the Executive Secretary. This individual, operating within the boundaries of the policies formulated by the Board of Directors, has been responsible for the general management of the Society. In the opinion of the Committee, this relationship should not change. It is, however, their belief that the title of the chief administrative officer is neither adequate today nor will it be in the future. A title that more adequately depicts and connotes the role of this individual to the industrial and management groups with whom he comes into contact should be considered.

4.14.7.1—It is, therefore, recommended that immediate steps be taken to change the title of the Executive Secretary to General Manager.

Although the National Headquarters staff has been altered and reorganized to fit the changing conditions and emphases of the Society in the past, it is the belief of the Committee that if the Society is to expand and grow in the future, the Headquarters staff organization will of necessity need further revision. This realignment should generally follow the recommendations outlined in a report made in 1955. It is to be pointed out that the present accounting system of the Society agrees with the proposed organization in the referenced report.

4.14.7.2—It is therefore, recommended that the Headquarters staff be organized along these lines. The transition to this staff lineup can be gradually made without disruption of any services or activities.

The Committee is of the opinion that the organization of elected officials of the Society will of necessity ultimately be oriented along similar lines. Although the presently established National organization is satisfactory, future Boards of Directors should review it and make changes as necessary to revise and re-orient its direction as necessary to support and direct the Headquarters operation.

The Society's Headquarters staff is vital to the continuity and stability of the Society. Therefore, it behooves the Society to provide working conditions and benefits that are comparable and competitive with American industry for those individuals in our employ. Based upon the Society's future growth rates, it is the Committee's opinion that the Headquarters staff will number in the vicinity of 150 employees by 1975. To provide for the accommodation of this working force and the Society's programs which they will develop, requires serious consideration on the part of the Society. The present facilities housing the Headquarters administrative staff are rapidly approaching their functional limits. Overcrowded conditions already exist in several departments. If we are

to maintain our position of leadership in the technical field, immediate steps should be taken to provide new facilities for the administrative staff. The Committee has deliberated at great length and detail upon the necessity of such a move. The pressing urgency for these new facilities represents only one part of the total picture of the Society's preparation for the future. Any expansion program must take into account the future role and related activities of the Society. To gain the place of leadership which is rightfully the Society's, necessitates a development project of the greatest magnitude. The Committee is of the opinion that the Society's expansion and development of its facilities to accommodate the new programs and ventures of the Society, should be a step by step process through the next fifteen years with facilities established by 1975 to effectively carry out the Society's programs. The administrative facilities should represent only the initial step in such an integrated plan. Additional structures should be constructed as the need and requirements for such facilities justify them.

4.14.7.3—It is, therefore, the recommendation of the Long Range Planning Committee that any future building site acquired or considered by the Society have sufficient land available for the gradual development of an over-all Society Headquarters operation encompassing not only the administrative but all other facilities requirements for the future as well.

As an initial phase of such a development:

4.14.7.4—The Committee recommends that steps be taken immediately to provide a new Headquarters facility capable of housing the projected number of Society employees by 1975. The final structure should be such type and construction that it will complement any additional structures that may be built to house future activities. Since we are speaking of the permanent Society Headquarters location, any structure considered should be designed with a minimum life expectancy of 25 years. The structure should combine functionalism from an operation standpoint with a promotional and publicity value to enhance the prestige of the Society.

The present Site Committee appointed by the President will determine the most advantageous location for development of the Society's center. Assuming acceptance of their recommendation, or upon the Board's final conclusion as to a permanent location of the future ASTME Center:

4.14.7.5—It is recommended that the Board of Directors appoint two subcommittees to work mutually toward the initiation of an over-all Headquarters facility program. One subcommittee should be responsible for final site location. This group would determine the specific location of the future center. The second subcommittee would function as a building committee. Their responsibility should lie in the realm of architectural and construction details. The Site Committee should report its findings to the Board of Directors at the 1961 Annual Meeting.

4.15—Final Considerations

It is the hope of the Long Range Planning Committee that the Board of Directors will take immediate steps to appoint the subcommittees for further study outlined in this report. These subcommittees are essential to the further refinement of the thinking and proposals of the Long Range Planning Committee. Time is of the essence and hence, the recommendation is in each instance, with the possible exception of the building subcommittee, for submission of their reports at the 1961 Annual Meeting.

The Committee's responsibility is fulfilled with submission of this report. It is believed the next phase of the Society's Long Range Program should be the formulation of a plan of action for carrying the Society toward the objective and goals presented in the introduction. As noted in the beginning of the report, priorities will need to be established for the implementation of those recommendations which meet the Board's approval. In the opinion of the Long Range Planning Committee, the development of a time schedule for the sequencing of the various recommendation is most vital. The Society stands today at the crossroads. The Committee has attempted to provide a broad general plan of action to assist in determining the future paths to be followed by the Society. The value of the recommendations must be determined by the Board of Directors, who in turn have the responsibility of implementing those which are considered to be of value.

As previously noted in the report, a revised Constitution and Bylaws of the Society reflecting the recommendations of the Committee is submitted as a guide to the National Constitution and Bylaws Committee.

4.15.1—The Committee recommends that petitions covering the proposed changes requiring referendum be prepared for submission to the membership for the required signatures. Upon acquiring sufficient signatures, [the changes] should be submitted to the National Constitution and ByLaws Committee for final preparation and legal checks. Following this step, the constitutional portion of those sections of the revised Bylaws affecting qualifications, classifications, and terms of office should be forwarded to the Chapter Constitution and Bylaws Committees for approval. If approved by the Chapter Constitution and Bylaws Committees,

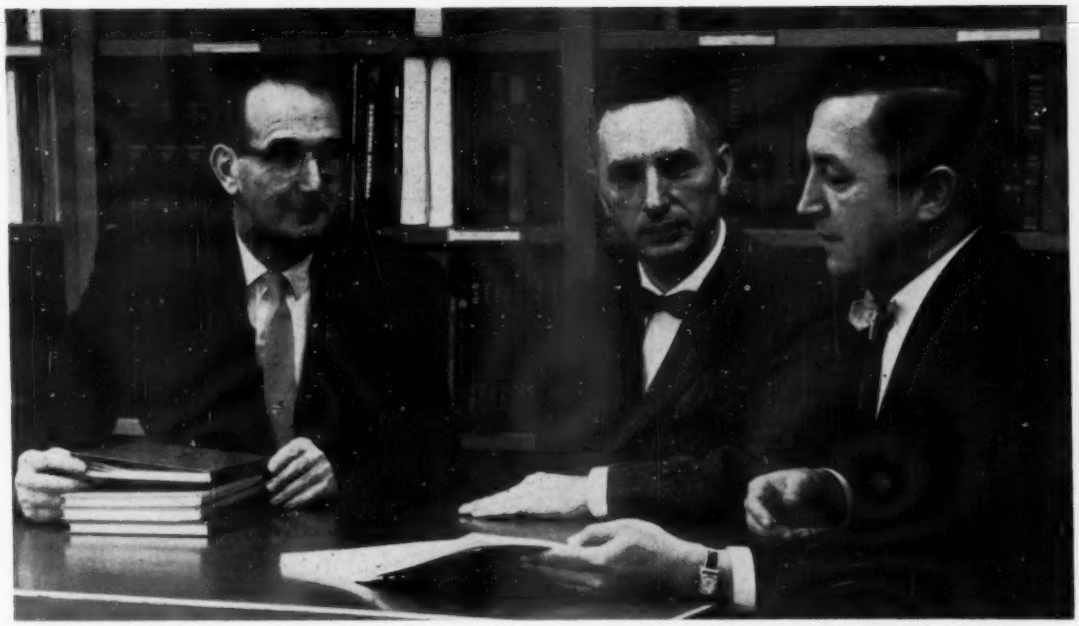
4.15.2—It is recommended that a referendum ballot covering the proposed changes be prepared and mailed to each member entitled to vote within 30 days after the date upon which that approval has been received.

Those portions of the Bylaws which have been revised and do not require approval similar to regular amendments to the Constitution shall be submitted to the Board of Directors at the 1961 Annual Meeting for action.

In conclusion, it is recommended that funds be set aside to cover the expenses of the subcommittees and the referendum ballot recommended in the report. The Committee specifically recommends that:

4.15.3—Twenty-five thousand dollars be set aside from the surplus of the 1959-60 fiscal year. These funds are to be allocated, as requested, by the Officer group to the subcommittees appointed by the Board as a result of the foregoing recommendation.

4.15.4—Seven thousand five-hundred dollars be set aside from the surplus of the 1959-60 fiscal year to cover the cost of the referendum ballot recommended in paragraph 4.15.2 and one printing of the revised Constitution and Bylaws conforming to the final approved changes.



NORMAN ZLATIN (left), Cincinnati chapter member and a recognized authority on machinability, has been appointed director of the newly established Machining Data Center of Metcut Research Associates, Inc. Here, with Dr. Michael Field, Metcut president, and John Maranchik, Jr., associate director of the data center, Zlatin discusses recent data concerning high-temperature and high-strength alloys for missiles.

Members in the News

R. P. SCHNEIDER, Piedmont chapter, has been appointed to a state-wide Advisory Committee for the guidance of North Carolina's Vocational Materials Laboratory, which is presently developing instructional materials in the field of mechanical technology. The newly established committee will assist the laboratory in determining training needs and in establishing a technical training program.

FRANK IANTOSCA, Boston Chapter 33, has been promoted from contract manager to plant superintendent at Walenar, Inc., manufacturers of missile components and precision machine parts.

John J. Prindiville, Jr., president of the Lapointe Machine Tool Co., recently announced the resignation of EDWARD M. DOWD, executive vice president of that company and member of the Boston chapter. In view of Dowd's resignation, George J. Bagnall was appointed vice president in charge of engineering and manufacturing, and William L. Gibbons, factory manager.

H. F. RUEHL, charter member and past chairman of Rockford chapter, received the "Supervisor of the Year" award from Fairbanks Morse Co. for his work as chief tool engineer of the firm's Beloit, Wis., plant. Ruehl has been associated with the Fairbanks tool division since 1924.

ROLAND A. PAUL, who received a $700 ASTME International Scholarship Award in 1959, is one of two Syracuse University graduate students now working on the WRC-ASTME welding research project at Syracuse.

CHARLES L. TUTT, JR., Saginaw Valley chapter, was recently named to the newly created position of dean of engineering at General Motors Institute, Flint, Mich., by GMI President Dr. Harold P. Rodes. The scope of the position will extend beyond the engineering field to include liberal arts and foreign-student programs as well as program development. Tutt, who since 1950 has been administrative chairman of the Institute's fifth-year, thesis and bachelor-master's degree programs, has also served as assistant professor of mechanical engineering at Princeton University; staff assistant for ASME in New York; associate editor of *Product Engineering;* and as a consultant on projects for the Air Force, Civil

Aeronautics Administration, U. S. Navy Bureau of Yards and Docks, and Chambersburg Engineering Co. He was graduated from Princeton in 1934.

ROBERT G. STEVENS, Lyndhurst, Ohio, has been promoted to purchasing agent of the Reliance Div. of Eaton Mfg. Co. Previously, he was senior purchase analyst on the staff of the corporate purchasing department. A member of Detroit chapter, he has served in the purchasing departments of Ford Motor Co. and the Kaiser Motors Corp. Eaton's Reliance Div. is located in Massillon, Ohio.

A. J. Hole, general manager of Ford Motor Co.'s Metal Stamping Div., has announced the appointment of DONALD PICKLES, Detroit chapter, as manufacturing and production engineering manager of the division. A 37-year veteran in automotive manufacturing operations, Pickles has been manager of the material forming and assembly department of Manufacturing Staff since 1951. In the newly created position, he will direct the consolidated activities of the production engineering, manufacturing engineering, material handling and work standards departments.

Westinghouse Electric Corp. has appointed LUTHER S. FRITCH, Western Reserve Chapter 115, as supervisor of tooling at their Muncie, Ind., plant. Fritch joined Westinghouse in 1945 at the inception of the Aviation Gas Turbine Div. and has recently been serving as a supervisor in the corporation's Sharon organization.

H. VERNE LOEPPERT, national treasurer of ASTME, was elected president of the Illinois Engineering Council at the annual meeting last December. A registered professional engineer in the state of Illinois, Loeppert is a past chairman and present member of the Chicago chapter, an active participant in the Council.

RONALD E. QUIGLEY, formerly sales supervisor for the Butterfield Div., Union Twist Drill Co., has been named district manager for Butterfield in the midwest area.

CHARLES R. BENDER, Cleveland chapter, has been advanced from assistant executive secretary to executive secretary of the National Tool, Die & Precision Machining Assn. He is succeeded by Jess R. Stevens, a former executive secretary to the Lorain County Home Builders Assn.

ARTHUR D. CHARBONEAU, member of Macomb chapter, has been appointed sales promotion manager for Hydro-Line Mfg. Co., Rockford, Ill., manufacturer of air and hydraulic cylinders. He had been sales representative for the company in the Detroit area for the past 3½ years.

JOHN E. FISHER, New Britain, Conn., was appointed sales engineer for the Elmwood Tool & Machine Co., Elmwood, Conn. Before joining Elmwood, builder of special tooling, Fisher was supervisor of the research and development laboratory of Underwood Corp. and did electronic installation work for the wartime Navy.

JOHN E. BASHFORTH, St. Louis chapter, has been appointed manager of U.S. Industries' Axelson lathe line, with headquarters at the Hamilton, Ohio, plant. Bashforth, who has worked for Axelson for 32 years in this country and abroad, also served as vice president of R.E.M. Sales, Inc., a machine tool distributing firm.

Robert G. Stevens

Donald Pickles

Luther S. Fritch

chapter news

Skokie Valley Joins the ASTME Family

SKOKIE VALLEY—The Society's newest addition is Skokie Valley Chapter 170, chartered last November at Morton Grove, Illinois. Launched with around 100 charter members, the group is largely composed of new ASTME members, rather than transfers from other chapters.

At the chartering ceremonies, national President H. Dale Long served as chartering officer and Verne Loeppert, national treasurer, as toastmaster. Long spoke to the group on economic competition in the world market. Other guests attending the affair included George P. Torrence, Jr., area captain on the National Membership Committee, and Clark Shafer, Chicago chapter chairman, with a delegation from the big brother chapter.

All pro-tem officers were elected at the charter meeting. They are: Charles M. Huss, chairman; Russell E. Doherty, first vice chairman; Earl F. Schiddel, second vice chairman; George C. Kurczek, secretary; and Donald E. Council, treasurer.

Charles M. Huss (right) receives the chairman's pin from Clark Shafer, Chicago chapter chairman, at the Skokie Valley chartering ceremonies.

Management's Role in Automation Is Explored

INDIANAPOLIS, Ind.—One hundred members, student members and guest executives from Indianapolis industry heard an engineer-executive discuss "Management's Role in Automation" at Chapter 37's annual Executive Night program recently.

The speaker, Stephen A. Derry, president of Derry Engineers of Louisville, Ky., declared:

"We are prone to think of automation as a mass producer of physical items; but there further exists the probability that automation, under the guidance of the qualified executive team, can also produce more knowledge."

Yesteryear's executives, Derry said, could make an irrational decision and then make it "stick." If today's executive does that, he will quite probably find himself looking for a new job. Tomorrow's executive will be entirely denied the privilege of making an irrational decision because a machine will make it for him.

"Tomorrow's manufacturing managers will be members of teams which will constantly increase in size," Derry concluded. "They must learn to accept innovations as everyday happenings."

Miklos Sperling, president of Merz Engineering Corp. of Indianapolis, reported on his recent tour of European industry. —*James J. Denny*

Toronto Members Help Remold a Man

TORONTO, Ont.—Most tool and manufacturing engineers know quite well that the worth of any material, human or otherwise, depends to a great extent on how well it is molded or formed. Cognizant of this, two Toronto chapter members recently tried their hand at helping reshape some costly but malformed human material.

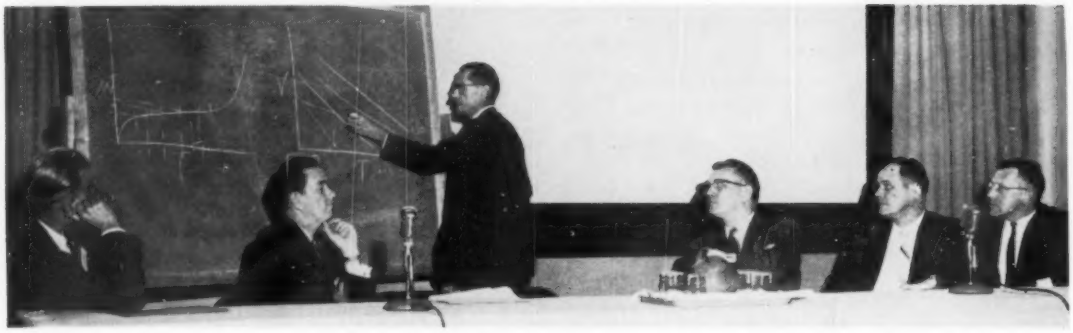
On behalf of Chapter 26, Chairman Jack Coomber and First Vice Chairman Ed Holden made the 200-mile trip from here to Kingston, Ont., to present a copy of the *Tool Engineers Handbook*. The winner of the book was the most outstanding machine shop trainee in the graduating class at the Colins Bay Penal Institution.

The recipient expressed his gratitude in a letter to the chapter. —*William M. Shaw*

special events

ASTME 29th Annual Meeting	May 20-26 1961	Statler Hilton Hotel New York City
ASTME 1961 Tool Show	May 22-26 1961	New York Coliseum New York City
Third Canadian On-Campus Conference	April 15 1961	McMaster University Hamilton, Ont.
ASTME Seminar "Automation and Numerical Control"	Feb. 22-23 1961	Bond Hotel Hartford Conn.

Panel Discusses Carbide Tooling



DETROIT—Plotting the variable forces that work against tool life in carbides, L. V. Colwell, professor of metal processing at the University of Michigan, uses the blackboard to put across his views during a panel discussion on carbide tooling at a Detroit chapter meeting. Other members of the panel are: (seated left to right) William Bader, vice president of research and development, Wesson Co., whose talk covered the problems of indexing throwaway inserts used in milling cutters and of holding dimensional accuracy when indexing to new cutting edges; George Hurley, supervisor of tool engineering, Engine and Foundry Div., Ford Motor Co., who discussed tool costs in changing over to new programs; J. Savage, technical specialist, Chrysler Corp., who used slides to illustrate parts, tools and machines used in the production of transmission and power steering parts; and Bernard E. Logsdon, general sales manager, Gairing Tool Co., who used an opaque projector to illustrate the use of throwaway inserts in multiblade cutter heads. Karl M. Moltrecht (right) acted as panel moderator. Appreciation certificates were presented to the moderator and panelists. *—Lloyd S. Hawley*

positions available

TOOL ENGINEER and PARTS PRICE ESTIMATOR—for small pneumatic tool manufacturing company. Government bidding experience desired. Write Boston Pneumatic Tool Co., 365 Arlington Ave., Brooklyn 8, N. Y.

MANUFACTURERS' AGENTS—Leading diamond tool manufacturer desires representation in the metal, glass, ceramic and allied fields. Consumer contracts essential. Lucrative income. Large percentage of repeat orders. Our unique method of manufacture has been extensively tested and approved by leading users. Write to Classified Ads, Dept. 196, 10700 Puritan Ave., Detroit 38, Mich.

positions wanted

MACHINE TOOL SALESMAN—with service and shop background. Well-known in New York City and metropolitan area. Wants position with machine manufacturer, manufacturers' representative or established machinery dealer. Well-qualified as sales engineer or district manager. Write Classified Ads, Dept. 195, 10700 Puritan Ave., Detroit 38, Mich.

SANTA CLARA VALLEY—Two members of Chapter 98, William T. Wright (center) and Don Panetta (right), inspect a turntable brought to the meeting by speaker John C. Denny (left), general manager of Die-Draulic Grip. Inc. Denny explained to the group how in some operations his company uses regular die sets, which blank, draw, form and reverse draw in one operation, to eliminate the need for double action presses and air cushions for forming, drawing and rolling as well as piercing from horizontal positions. *—Carl A. Strombom*

CALIFORNIA POLYTECH—"Tooling the DC-8", an illustrated talk by a tool engineer from Douglas Aircraft Corp., revealed the model airplane experts in Student Chapter 12. Dick Brockett (left) and Ray Working examine a miniature plane supplied by the speaker.—*Richard Olson*

SEATTLE—Members and guests of Chapter 39 examine some electronic components for airplanes and missiles in an attempt to guess how they work and how they are used. Three officials of United Controls Corp. brought the components to a recent meeting to illustrate their discussion of United's tooling and production problems. The speakers also described the history of the company. *—Ray Clift*

Tools on Display

SYDNEY—Backed by this wide selection of die sets, attachments and components, Roy Moase, member of Sydney chapter and a plant superintendent at International Resistance Co. Ltd., showed his own ASTME group how split ground dies can reduce costs, relieve maintenance and lower tooling downtime. Moase's talk covered design techniques, tooling, wheel-dressing, forming and die mounting. *—George J. Moulang*

EVANSVILLE, Ind.—Examining the props of speaker Graydon Whitecotton (center), president of Hy-Do-Lignum Co., are Chapter 73 Chairman John Chaus (left) and Richard Martin, a factory representative. Whitecotton recently informed Evansville chapter members on the development and current applications of steel rule, form and draw dies.—*Ed Seibert*

MACOMB COUNTY—By using his ingenuity and the material at his disposal, man has produced tools to relieve his work load and to obtain a better finished product in less time, said C. G. Schelly, (left), director of educational research at the DoAll Co., in a recent talk to Chapter 142. Here, he explains a display of cutting tools to five Macomb chapter members. Left to right are Chairman Ted Ekman, First Vice Chairman Mike Bentz, Edward Wudarcki, Herbert Hiser and Wayne Kay. *—Cecil L. Monroe*

Speaker Compares Pumps at Windsor Meeting

WINDSOR—Discussing the differences between the radial type piston pump and the vane type pump are (left to right) Harold Porter, manager of Upton Bradeen & James Ltd.; Donald A. Bohn, sales engineer of Racine Hydraulics & Machinery Co. Inc.; and Ray Smith, chairman of Windsor chapter. Bohn spoke to the chapter on the two pumps and their individual methods of control. Because the vane pump has only one power source, he said, its feedback system cannot be controlled to affect the circuit as efficiently as that of the radial type pump. *—G. F. Burford*

Chapters Host ASTME Officers

TUCSON—David A. Schrom (right), national vice president, speaks to a group of Chapter 106 members on "The Tool Engineer at Home and Abroad" during his recent tour of the western chapters. Left to right the group consists of (standing) Harry O. Moore, William H. Helsper, Lester E. Arndt, (seated) Howard D. Larcom, Williard J. Torbeck and John W. Enlow. ***—G. H. Moritz***

OGDEN, Utah—At a joint meeting of Ogden chapter and Utah State University student chapter, Society President H. Dale Long (center) gets together with the two chairmen: H. B. Muhlestein (left) of Student Chapter 2 and E. O. Jenkins of Chapter 156. After presenting Robert Goad with a scholarship award sponsored by Chapter 156, Long spoke to the group on foreign manufacturers and their effect on the American market. ***—Ed Mifflin***

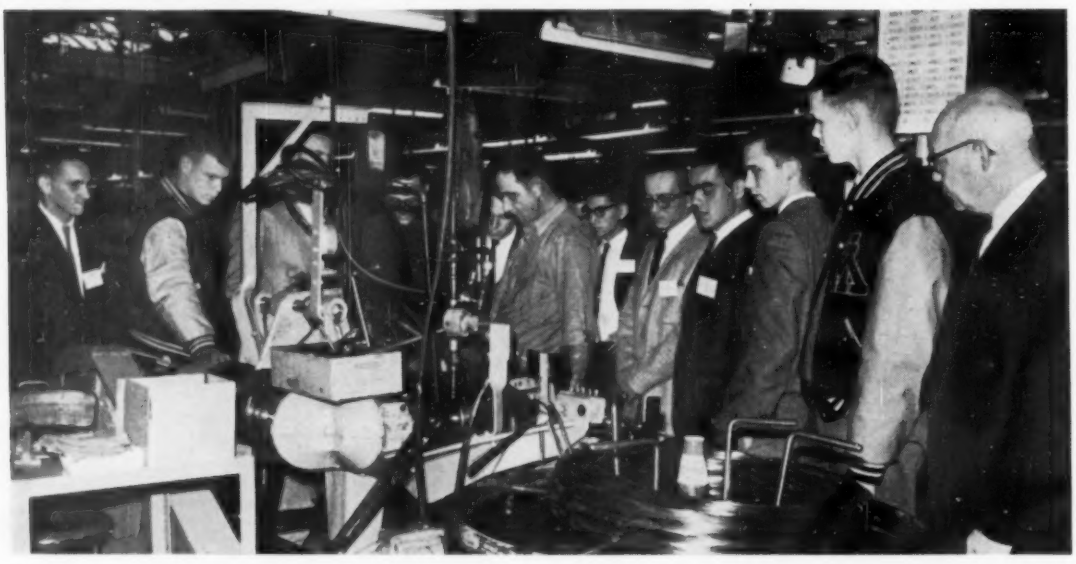
MONMOUTH—High spirits prevail as Past Chairman Michael R. Lettieri prepares to cut cake in celebration of Monmouth chapter's fifth anniversary. Watching with smiles are (left to right) ASTME President H. Dale Long, Vice Chairman Carl A. Anderson, Chairman Harry A. Williamson and Secretary Eugene P. Noris. In honor of the anniversary celebration, Long presented a speech entitled "Your Future—Bright or Gloomy?" ***—Russell W. Pucker***

Students Win ASTME Honors

MOHAWK VALLEY—Presenting a $400 International Education Award to Angelo C. Pallaria (center right), member of Canton Tech student chapter, is John T. Dizer (center left), faculty advisor of Student Chapter 10. Looking on are Don McKay (left), chairman of Mohawk Valley Chapter 78, and O. J. Seeds, guest speaker at Chapter 78's monthly technical meeting. The affair was attended by 70 members and guests. *—Carl J. Dingman*

HAMILTON DISTRICT—Congratulations are in order for Werner Grabe (right), a full-time day student at the top of his class at Hamilton Institute of Technology and a full-time night worker at a steel company. Chairman Ronald Tipping (left), has just awarded Grabe a $200 grant from Chapter 42. Looking on is D. H. Craighead, HIT principal. *—John Hutzler*

Chapter Gives Students a Look at Industry



MUSKEGON, MICH.—Over 300 senior high and college students planning careers in engineering and other technical fields, were given a better understanding of engineering problems at Muskegon chapter's fifth annual Student-Industry Day. The chapter and 22 major industries cooperated in planning a program that would encourage the students to continue their technical education. The day began with a keynote speech, "Looking Ahead," by C. W. Bemer, former superintendent of the Muskegon Public Schools. After the talk, representatives of the various industries took groups of from 5 to 40 students on guided plant tours for the rest of the morning. The group shown is inspecting a production process at the American Coil Spring Co. plant. In the afternoon the students participated in group discussions, held by the industries and covering the different aspects of engineering problems. The program for the affair was supervised by Edward J. Huttenga, first vice chairman of Muskegon chapter; and Gordon J. Martiny and Gerritt Dolislager, co-chairmen of the education committee. The students were from Greater Muskegon, Grand Haven, Whitehall and Muskegon Community College. *—Arnold E. Kolberg*

Reports in Brief . . .

Northeast

A. W. Nelson and John H. Olson, both of Englehard Hannor Inc., discussed the grading, mounting, mining and use of industrial diamonds at a recent technical session of FRAMINGHAM chapter. . . . ELMIRA chapter's monthly meeting consisted of a symposium on heat-treating, moderated by Carlton Beach of Corning Glass Co. The members of the panel were: Edward Englehardt, Sr., Owego Heat Treat Inc.; William Connors, Hardinge Brothers Inc.; Joseph Rapach, Eclipse Machine Div., Bendix Aviation Corp.; and Prof. Malcolm S. Burton, Cornell University. . . . Charles R. Eltinge and Lad J. Bayer, both of Warner & Swasey, recently described the application and effects of numerical control to members of BALTIMORE chapter. . . . WORCESTER chapter presented awards for fixture designing to three students of Worcester Junior College. Donald R. Lippe received a $25 prize; Roy H. Rehbein and George L. Saucier were presented with copies of the *Tool Engineers Handbook*. . . . At a recent meeting of the CATSKILL REGION chapter, Jerome Barnum, president of Jerome Barnum Associates Inc., Harrison, N. Y., explained the principles and techniques of salesmanship for the engineer.

Midwest

A total of 315 ST. LOUIS chapter members recently toured the new and modern Chrysler assembly plant in Valley Park, Mo. . . . For the monthly meeting of CINCINNATI chapter, members journeyed by bus to Hamilton, Ohio, for a tour of the Fisher Body plant there . . . . Speaking before a LANSING chapter meeting, Bruce Lockaway, sales engineer at Fosdick Machine Tool Co., described the "Numerical Control of a Precision Boring Machine." . . . Executive Night at KALAMAZOO chapter drew a crowd of 140 members and guests. Speaker for the evening, ASTME Vice President David A. Schrom, captivated his audience with a humerous and challenging talk on "Running a Plant with Squares." . . . A group of 85 KANSAS UNIVERSITY student chapter members and staff members recently took a field trip to the Griffin Wheel Corp., Kansas City, Mo., manufacturers of railroad car wheels. . . . CEDAR RAPIDS Chapter 71 learned of achievements in the field of structural adhesives when Jack S. Alyea, technical representative for Minnesota Mining and Manufacturing Co., spoke at their monthly meeting. . . . The DENVER chapter Service Award was presented to Herb Tautz at a recent meeting for his successful management of the group's Directory committee. Speaker for the evening was national Vice President David A. Schrom.

South

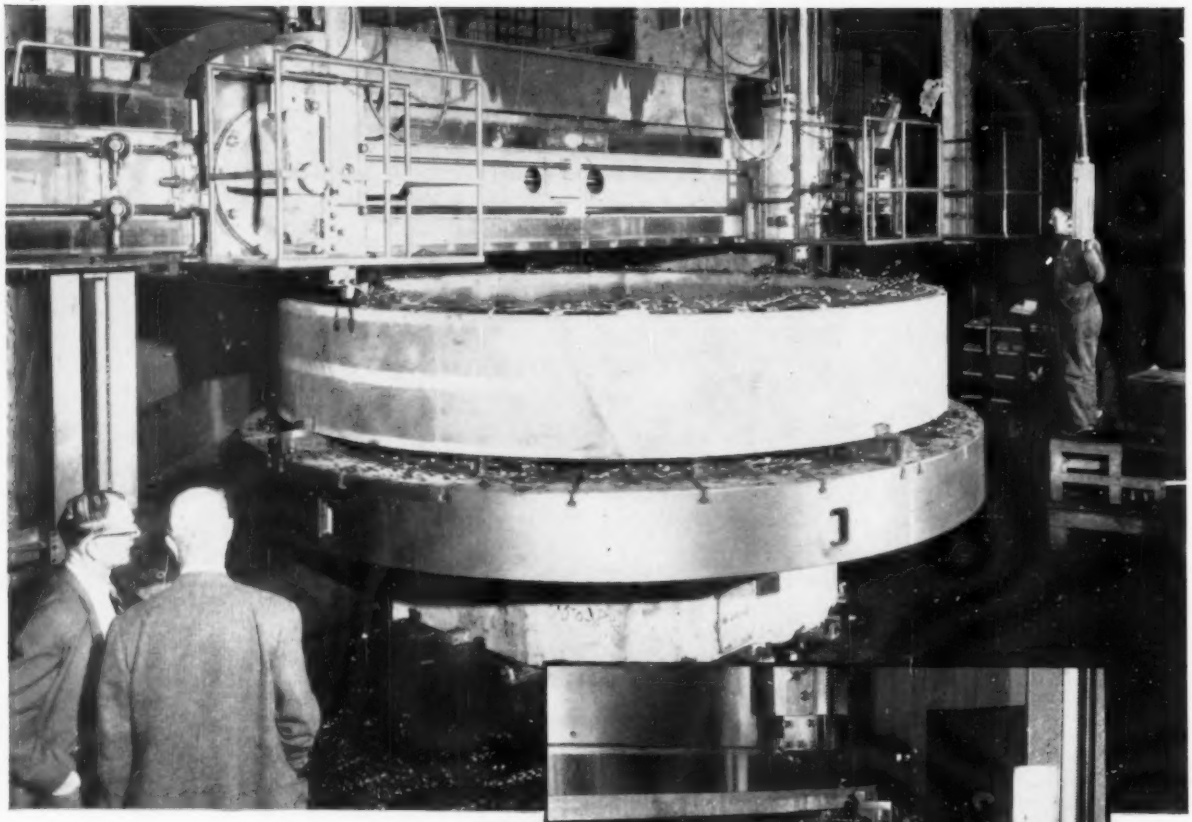
At a joint meeting of the Supervisors' Association of the U. S. Naval Ordnance Plant and LOUISVILLE chapter of ASTME, C. G. Schelly, director of educational research for the DoAll Co., explained the vital importance of cutting tools in the preservation of the American way of life in the space age. . . . A program on the past, present and future of man-made diamonds was presented by the General Electric Co. and The Carborundum Co. at a recent meeting of the NASHVILLE chapter.

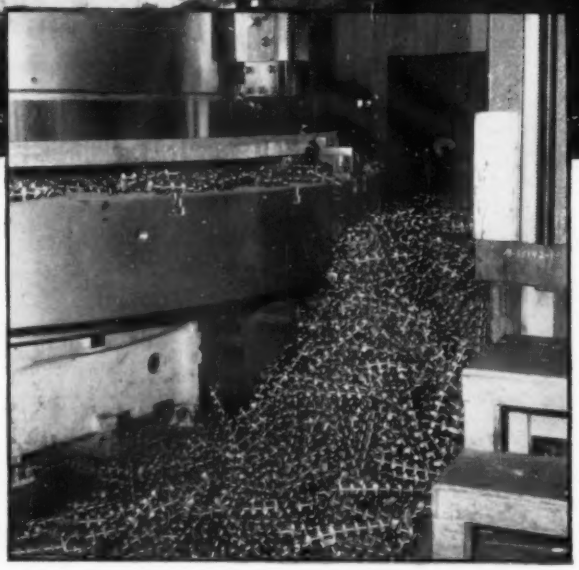
Southwest

Speaking on the "Economics of Numerically Controlled Machine Tools," W. E. Lowrey, manager of development and test engineering at A. C. F. Industries, told ALBUQUERQUE chapter of the greater productivity per man hour resulting from his company's use of numerical control. Their numerically controlled template-making machine, he said, reduced the over-all cost of manufacturing templates to less than 46 per cent of the cost with conventional methods . . . . SAN ANTONIO chapter was recently host to David A. Schrom, national vice president. Schrom encouraged the group in their efforts to further industrial development and to advance technical education in the San Antonio community. . . . "Tomorrow is Today," a talk by national Vice President David A. Schrom, keynoted Industry-Education Night for PHOENIX Chapter 67. In order to advance at the necessary accelerated pace, said Schrom, people in this country will have to learn to read, listen, communicate and comprehend. Other guests attending the affair were Dean Thompson, Arizona State University, and Amos Hoff, director of engineering at Phoenix College.

West Coast

While touring United Air Lines Maintenance Base, SAN FRANCISCO chapter members visited both the piston engine and jet engine repair facilities. At the conclusion of the tour, P. A. Wood, assistant vice president of engineering and maintenance, spoke on the history of the base and plans for the future. A. R. Sandell, production planner, outlined the production planning of airplane overhaul.





Two VR-75 Carbide Inserts removed 2 tons of chips from a 22 ton cast steel workpiece approximately 14 feet in diameter. Tool travel was several miles per insert.

This outstanding V-R tool performance was done on a 20 foot vertical boring mill built by Giddings & Lewis Machine Tool Company for Verson Allsteel Press Company of Chicago. The machine was operated with ½" depth of cut, .046" feed per revolution, 4.6 RPM, 230 SFM with both heads cutting and using 100 HP. At this pace, 135 cubic inches of metal were removed per minute. A finishing cut followed using 8 RPM, 360 SFM with .023" feed per revolution.

Such successful case histories are not unusual at Vascoloy-Ramet. V-R's exceptional carbide quality will give you the same outstanding service. Call your V-R man in today, or write for a fully illustrated catalog.

4,000 pounds of chips removed with only two VR-75 Carbide Inserts

CREATING THE METALS THAT SHAPE THE FUTURE

V-R VASCOLOY-RAMET

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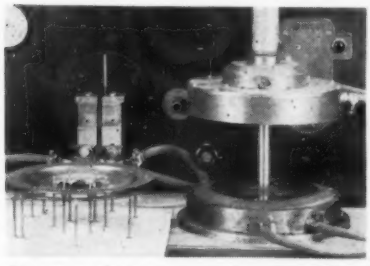
Progress in Production

TWO-POSITION SETUP ELIMINATES WARPAGE IN HEAT-TREATED BLADES

To solve the problem of distortion and warpage in the heat-treating of circular stainless steel cutter blades, Induction Heating Corp., Brooklyn, has designed a special two-position setup.



Circular blade on work coil (left) is transferred to quench station (right) in two-position setup for heat treating.

With this setup, the cutter blade is first positioned over a work coil that is designed to lay down a heat band only 15/16 inch wide. The necessary 2000 F heat is supplied by a 25-kw generator, and in 30 seconds the blade is edge-hardened. The hot part is then transferred to a device that is essentially a quench station. A hydraulic cylinder forces the upper plate down onto the hot blade and the lower quench block. Continued application of pressure keeps the blade straight while air, under pressure, rapidly cools the part to a level at which water-cooled quenching can take over. At the completion of the operation, the blade is still flat, the hardness is uniform and the original quality of the blade is retained. No follow-up grinding operations are necessary to eliminate warpage, and finishing time is substantially less than that required by other heat-treating processes.

WATER FORMS PARTS OF THIN STAINLESS STEEL

Using a high-energy rate forming machine—Dynapak—that forms, extrudes and forges high-strength metals, Convair Division of General Dynamics Corp. is forming tank caps of 3/32-inch-thick stainless steel. A die cavity containing water is placed under the ram of the forming machine. A blank of stainless steel is laid across the mouth of the die and the die turned upside down over the water. When the ram is fired, the water, being noncompressible, forces the steel back into the die to form the tank cap. The Dynapak machine is also used to form, in a single stroke, missile parts that previously took three hours to turn out in the machine shop.

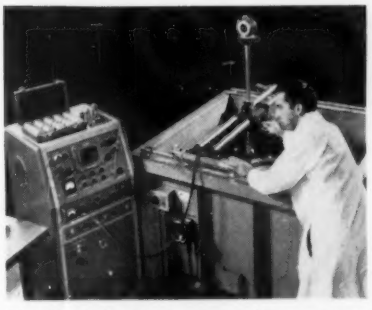
Tank cap being measured was formed by high-energy rate forming machine. Die cavity is shown under ram of machine and die is in left foreground.

ULTRASONIC INSPECTION SPOTS DEFECTS IN STEEL

Ultrasonic inspection of steel—used to detect shrinkage, internal cracks, flakes, concentrations of inclusions, segregations and laminations as well as particle and bubble defects—is at present undergoing improvements to meet the nuclear and missile industries' demands for steel that is free from defects. The ultrasonic method of detecting depends on a beam of high-frequency sound waves that is projected into the steel. A small physical defect in the path of the beam acts as an obstacle to the beam and is thus picked up on a cathode-ray tube screen.

At Allegheny Ludlum's Forging and Casting Division, Detroit, the steel shapes are submerged into a stainless steel tank of water because water increases the sensitivity on thin sections and makes it easier to find minute defects. The ultrasonic waves are generated by a quartz crystal attached to a cable that serves as an electrical connection with equipment housing the cathode-ray tube. A metal rod encloses the section of cable submerged in the water. This ultrasonic examination in no way damages the steel object being tested.

Before the plant began using ultrasonic equipment, a background of experience was built up in the interpretation of the indications on the cathode-ray tube. Standards were established by designing blocks of metal with varying amounts of intentional defect, usually created by drilling exacting holes into the block. When the blocks were examined by the ultrasonic device, the degree of variance with each size hole was recorded. A special set of blocks was designed for each type and grade of metal and from these, metallurgists can now tell by the scope line how large the defect is and where it is located in the steel that is being tested.



Finished forgings are submerged in testing tank (right) and checked ultrasonically for internal defects. Defects show up on cathode-ray tube (left).

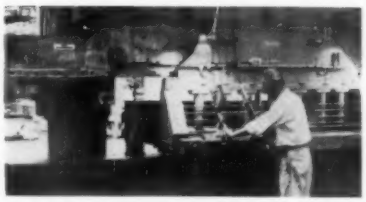
DOUBLE DUTY MACHINE FORMS AND SHEARS

A hydraulic press brake combined with a shearing attachment is forming sheet metal parts as well as shearing heavy plate at General Electric in Evandale, Ohio. When cutting ½ to 1-inch plate, the machine minimizes slow burning, increases the shearing capacity of the plant and equals conventional shears in high-speed cutting. When

cutting 3/8 to 3/4-inch stainless and mild steel up to 1-inch-thick, accuracy ranges from 0.060 to 0.090-inch over six feet of shear length.

Because the machine shears with a cushioned, shockless hydraulic stroke, it is still cutting with the original knife after six months of use. For rapid installation and removal of the shearing attachment, the company is contemplating the use of a jack type conveyor table operating on trolley tracks on the floor.

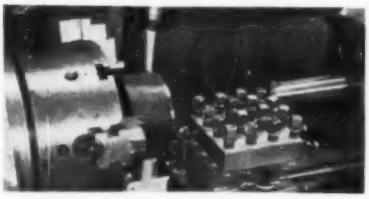
Used as a press brake, the machine forms mild and cold rolled steel, stainless and Inconel parts for jet engines. The press brake is made by Pacific Industrial Mfg. Co., Oakland, Calif.



Press brake has horn on left end of ram to permit forming operations while shearing attachment is in place.

CARBIDE INSERTS UP TOOL LIFE AND DOWN MACHINING TIME

Carbide inserts of a special steel machining grade have lengthened tool life and reduced machining time in a gear blank cutting operation at Universal Corrugated Box Corp., Linden, N. J. In a typical run involving 16 gear blanks, the complete cutting job—formerly accomplished with six cutting edges of three inserts—requires only one edge of one insert. Approximately 90 minutes of machining time is saved. The inserts are Grade 434, made by Adamas Carbide Corp., Kenilworth, N. J.

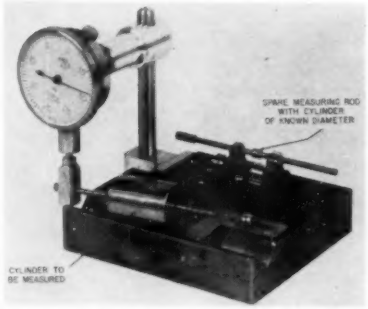


Gear blanks are cut with carbide inserts of a special steel machining grade.

"WOBBLER" MEASURES SMALL HOLE DIAMETERS

A relatively inexpensive device for measuring the internal diameter of small holes to an accuracy of 0.0002 of an inch is being used at the Naval Ordnance Laboratory, White Oak, Maryland. The instrument determines hole sizes in explosive test fixtures used to measure the sensitivity of various explosives as a function of their density, composition, physical size and environment.

Called the wobbler, the gage is basically a cylinder attached to a rod that is connected to a dial. The cylinder, having a diameter slightly less than the hole to be measured, is inserted in the hole of the test fixture and the rod is rocked by hand. The dial measures the movement of the rod and thereby indicates the diameter of the hole.



Internal diameter of cylinder is measured by high precision gage.

ARMSTRONG

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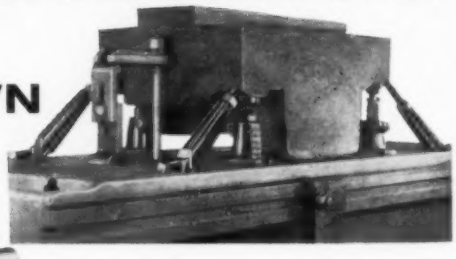

Whatever its shape, a work piece can be quickly, easily and safely set up on any T-slotted table with ARMSTRONG Set-up Tools. Comprising a complete "system" of supporting and holding devices in all essential sizes, ARMSTRONG Set-up Tools usually pay for themselves on the first job and continue to lower costs for years to come.

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Prevent Accidents—end risk of set-up failure with resulting tool breakage, damage or personal injury.

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Your Local Armstrong Industrial Distributor carries a good stock of Set-up and Hold-down Tools. He offers you quick, efficient service on these, as well as other, quality ARMSTRONG Tools.

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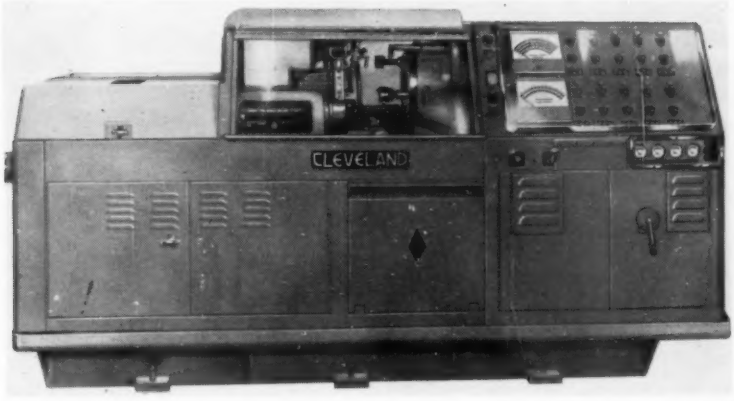
TOOLS of today

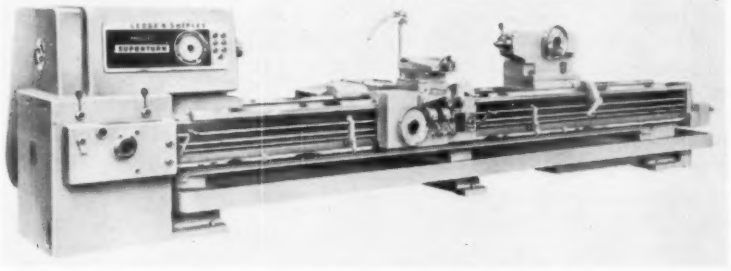
Bar Automatic Is Program Controlled



Speed and feed rates are set by control knobs and indicated on monitor dials of the 1⅝-inch model AB single spindle bar automatic. It has 10 separate infinitely variable spindle speeds from 40 to 3100 rpm and 10 infinitely variable turret tool feeds. No change gears or feed cams are involved in changing the five turret positions and the speeds and feeds selected repeat until changed. Other features include universal camming and simple, hand-crank adjustment of the length of bar stock feed.

Cleveland Automatic Machine Co., Cincinnati 12, Ohio. **Circle 401**

Engine Lathe Uses Ceramic Tooling

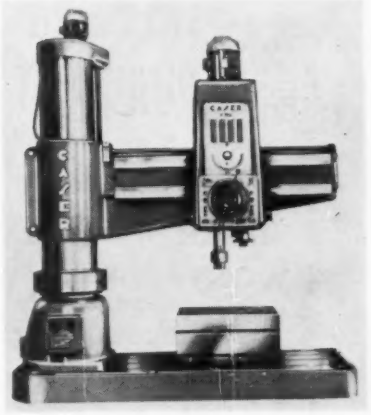


Designed expressly for ceramic tooling, this lathe has three speed ranges of 32 speeds: 8 to 1016 rpm in the standard range; 10 to 1246 rpm in the intermediate range; and 12 to 1528 rpm in the high range. A maximum of 60-hp capacity is provided. The Superturn is available in two models—2516 with a 16-inch-diam swing capacity over the cross slide and 28 inches over the bed and carriage wings, and 2516-21 which swings 21 inches over the cross slide and 32½ inches over the bed and carriage wings. Both models are equipped for preselected automatic shifting and four-way rapid traverse.

Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio. **Circle 402**

Radial Drills Have Preselected Speeds

Three radial drill models have a 21, 25 and 29-inch column with 7, 8 and 10-ft arm, respectively. They have electrohydraulically preselected speeds and feeds. The 32 speeds range from 12 to 1500 rpm. The spindle is controlled by a hydraulic clutch. Other features of the models include an electromagnetic overload safety device for the feed, push-button controlled up-and-down movement of the arm, automatic locking and unlocking of the arm on the column and



electrohydraulic pushbutton clamping of column and drilling head.

Hermes Machine Tool Co., Inc., 48-15 Northern Blvd., Long Island City 1, N. Y. **Circle 403**

Back Spotfacer for Internal Surfaces

Surfaces inaccessible to conventional machining can be faced in one operation with this backspot facing tool. When a collar on the tool bottoms against the workpiece, continued travel of a spring-loaded spindle exerts pressure on the toolholder, forcing the cutting blade out to perform the facing

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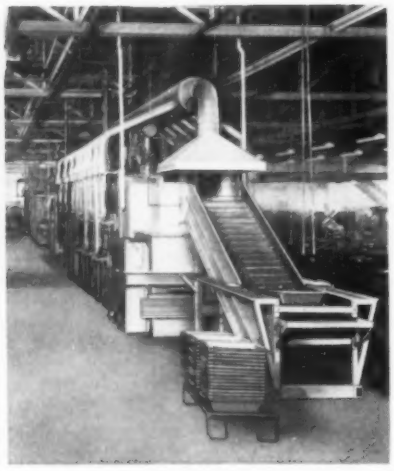

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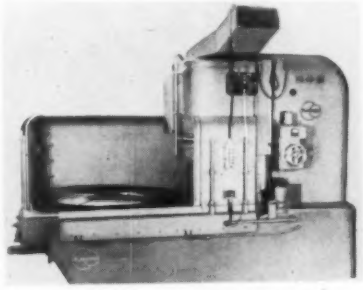
operation. As the spindle retracts, the blade withdraws into the shank to permit a free return stroke. For parts that also require outside hold chamfering, a removable chamfer blade can be attached to the tool.

Cogsdill Tool Products, Inc., 12980 W. Eight Mile Road, Oak Park 37, Mich. **Circle 404**

Surface Grinder Holds Five Tons

This vertical spindle surface grinder —No. 48-96—has a 96-inch-diam, full magnetic chuck, and will swing and grind to the center of work as large as 108 inches in diameter. The chuck will hold a maximum work load of 10,000 lb. Work up to 40 inches in height can

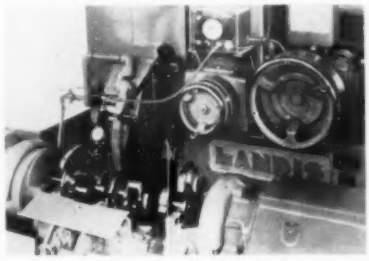


be accommodated under the 48-inch-diam segment wheel. The chuck completely clears the wheel when in the loading position. Regularly supplied with a 100-hp spindle motor, the grinder is also available with motors up to 150 hp.

Blanchard Machine Co., 64 State St., Cambridge 39, Mass. **Circle 405**

Grinding Gage Sizes Workpiece

This gage can be installed on any plunge-cut cylindrical grinder that has a hydraulically-powered wheel slide mechanism. The Econo-sizer is a single-



limit control gaging unit which has a power-handling relay operating directly from an air-electric switch to initiate the control signal for retracting the grinding wheel. The unit has cushioned response to work size variations so that minor surface irregularities which could improperly influence the control action of the gage do not affect it.

Federal Products Corp., Providence 1, R. I. **Circle 406**

Ultrasonic Unit Welds, Solders

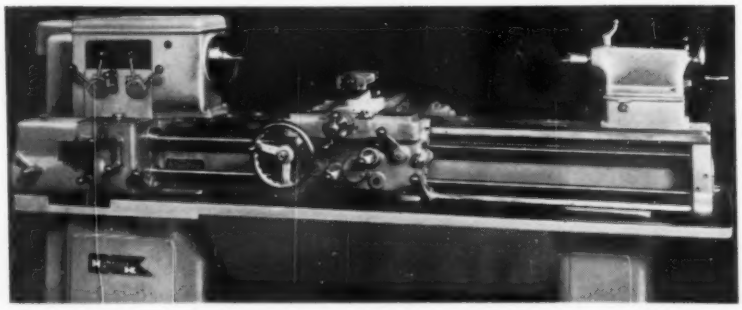
This table-sized unit is capable of welding leads as fine as 0.0001 inch in diameter and can also be used for soldering. It is available as a kit with an ultrasonic transducer handpiece, four basic inserts for tweezer welding and spotwelding, and a vibrating table. Any ultrasonic generator can be used to power this device.

Cavitron Corp., Long Island City, N. Y. **Circle 407**

Compact Lathe Handles All Operations

All conventional turning, boring, facing and thread chasing operations can be handled on the Model K lathe. Swing over the bed is 16 inches; swing over the cross slide, 10 inches; and center distance, 54 inches. It has 16 geared speeds in a range of 28 to 1200 rpm. All U. S. standard and U. S. fine threads are included in the 48 thread range. Feeds per revolution range from 0.0012 to 0.070 inch. The machine is powered by a 5-hp drive motor.

Monarch Machine Tool Co., Sidney, Ohio. **Circle 408**



Chucking Machine Handles Many Parts

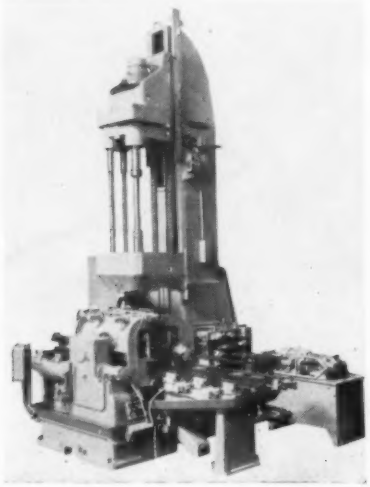
This automatic chucking machine, which has an air chuck mounted on a spindle specially designed for chucking work, can handle irregularly shaped parts as well as simple slugs. The chuck has a 3-inch capacity and a 4-inch swing over the cross slides. The chuck jaw movement is $\frac{3}{32}$-inch on diameter allowing over-the-head chucking where required. Fifteen spindle speeds on the high range are provided with a

top speed of 2095 rpm for jobs requiring a spindle reversal during the cycle and two higher speeds to 2905 rpm are available for nonreversing applications. Standard equipment includes both automatic and manual controls, a 3-jaw chuck, a six-station turret, two cross slides and a spindle brake on neutral for loading purposes.

Brown & Sharpe Mfg. Co., Providence 1, R. I. **Circle 409**

Boring Machine Has Long Stroke

This hydraulic feed, one-way three-spindle vertical line-boring machine has a 48-inch stroke. A hydraulic feed locates the workpiece in the fixture, which aligns the work holes with the boring tools. Before starting rotation, boring bars approach work in rapid traverse

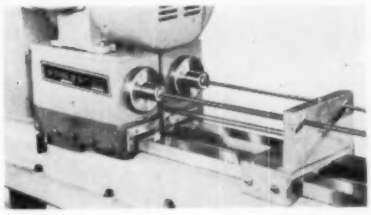


until the pilot diameter enters the bore. Approach feed stops, spindle rotation begins and the boring bars feed to full depth. After boring, the tools retract and the indexing fixture revolves, discharging the workpiece. The head rides on vertical square ways, with 0.0005-inch accuracy over the entire 4-ft travel. The machine is powered by a 5-hp motor.

Foote-Burt Co., Cleveland 8, Ohio. **Circle 410**

Gun-Drilling Unit Has Two Spindles

Workpieces that lend themselves to close center fixturing are suited for the dual spindle gun-drilling power unit. Finished holes can be drilled from solid materials in one pass on a production



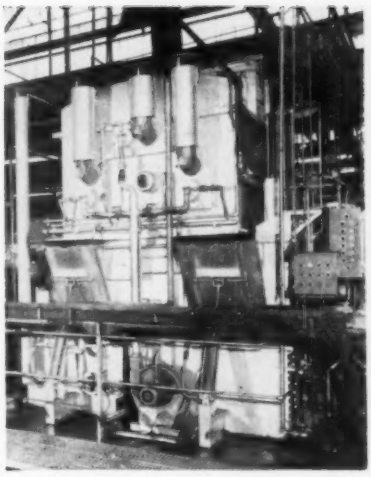
basis. Diameter-to-length ratios as high as 288 to 1 are possible, with a minimum runout of 0.0003 inch. This unit readily adapts to one-of-a-kind or semi-production work with one or both spindles operating. It is available with hydraulic or positive drive mechanical transmission on the 12 and 24-inch strokes. Infinitely variable feed rates from 0.0001 ipr to 30 ipm can be coordinated to operate with spindle speeds to 10,000 rpm.

Drillmation Co., Inc., 6500 E. Eleven Mile Rd., Center Line, Mich. **Circle 411**

Machine Cuts, Forms Axial Leads

Fully electrical in operation, this machine interchangeably cuts, forms or cuts and forms lead wires of axial lead components used in electronic assemblies ranging in size from miniature glass diodes to large axial lead capacitors. Components can be processed loose or from packs without modifying any part of the machine at a rate of 11,000 pieces per hour. Settings for component lead strength, bend length and body size are made by adjusting individual micrometer type leadscrews. Cut and bend lengths are indicated by

USE READER SERVICE CARD ON PAGE 183 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION



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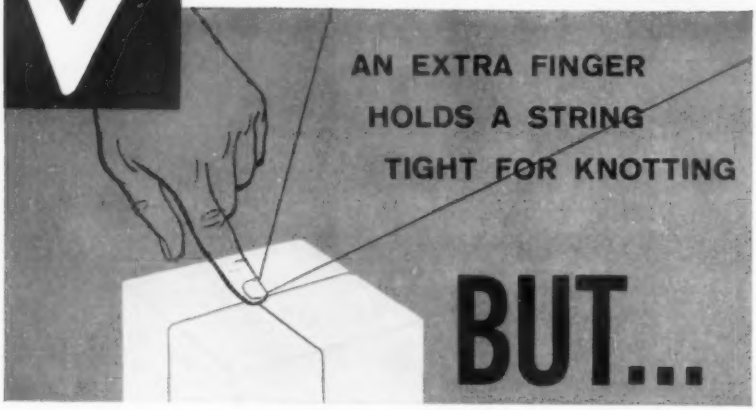

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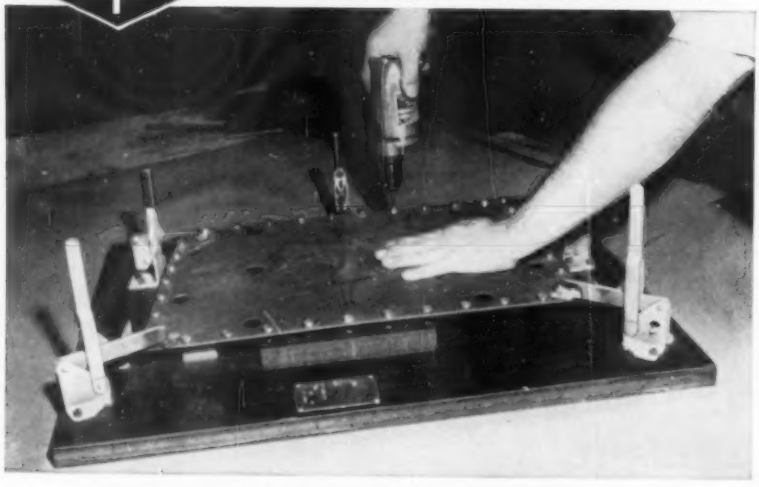

Simple drilling fixture made up of 5 toggle action clamps mounted on a plywood base holds drill bushing plate firmly in position.

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measuring devices built into the machine. The machine requires no tools, additional die sets or extra parts for its operation.

Heller Industries, Inc., 70 S. Munn Ave., East Orange, N. J. **Circle 412**

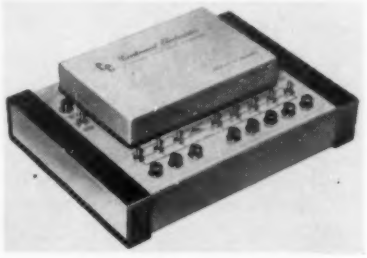
Two-Spindle Drill Unit is Adjustable

Close-center multiple drilling and tapping work in steel up to ⅛ inch thick can be done by the adjustable two-spindle drillhead. Model 200 Multidrill may be mounted on any drillpress or drill unit to drill or tap two holes at a time. The two spindles can be adjusted to drill or tap a wide variety of hole patterns in a 2-inch-diam circle. Special tapping spindles include an adjustable depth spindle which permits holding fine adjustments through a range of 5/16 inch in steps of 0.001 inch and a pitch compensating spindle for simultaneous tapping with taps of different pitch.

Commander Mfg. Co., 4225 W. Kinzie St., Chicago, Ill. **Circle 413**

Fluid Power Control Center

This portable control center can be used to control solenoid valves which in turn control pneumatic or hydraulic equipment or to control relays, switches, motors, lights or other electrical devices directly. The instrument itself is controlled by an eight channel tape for fully automatic, semiautomatic or manual programming. It initiates an on-and-off circuit in eight separate switches, at



any time interval from 30 ms to 2 yr. One channel can be made to control any other channel or all other channels; any or all channels can be controlled from an external source; or one or more channels can be operated manually in an otherwise fully automatic sequence. Each channel has a latching relay.

Crestmont Electronics Div., Crestmont Consolidated Corp., 2201 W. Burbank Blvd., Burbank, Calif. **Circle 414**

M1238-1818 — *Range 18" x 18", working distance 9" to infinity. Reads to 0.001" up to 24" working distance. Protractor ocular reads to 3 minutes of arc. Image is erect.*

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These convenient, reliable optical instruments permit making precise coordinate measurements in a vertical plane. The two dimensions are measured with one setting, object does not have to be rotated. Inspection time is cut in half and resetting errors eliminated.

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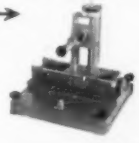
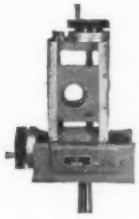
Because these are optical rather than mechanical measuring instruments, you make non-destructive measurements without contact, distortion, or concern about pressure being applied to the object when making a setting. Instruments available in English or Metric system.

M1236-46— Horizontal range 6", vertical range 4". Reads to 0.0001", working distance 5" to infinity.





M1236-22— Range 2" x 2", reads to 0.0001". Working distance 5" to infinity. Shown with 19 mm mounting rod, and without telemicroscope. Instrument permits precise coordinate movement of other objects such as photo cells, probes, etc., in place of telemicroscope.

The Gaertner Scientific Corporation

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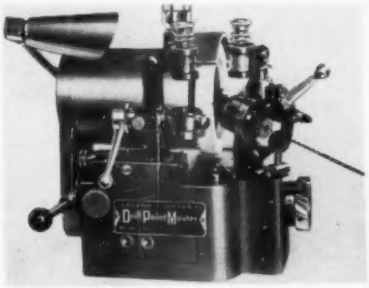
Drill Sharpener Grinds Any Point

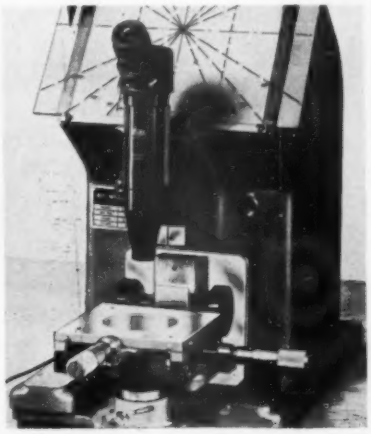
Any desired point on any drill from No. 80 to 0.250-inch in diameter can be produced and reproduced with the Drill Point Master. Among the features of this drill grinder are independent adjustment of point angle, lip length and relief angle; two variable power microscope viewers and sealed beam light to assist in precise setting; point angle adjustment from 60 to 180 deg; lip relief from 0 to 26 deg; and point thinning controlled to 0.001 inch by micrometer adjustments of wheel slide and point thinning carrier. All settings can be logged for exact duplication at any time. The machine has a sandwich wheel for clean, dry grinding and point thinning without burning.



Leland-Gifford Co., Worcester 1, Mass. **Circle 415**

Small Parts Comparator Projects Large Image

This small parts comparator combines in one instrument both an optical bench comparator and a toolmaker's microscope. When used as a bench comparator, a correct—rather than an inverted or reverted—image is projected. All work is viewed from the top face or surface of the sample being inspected and both the sample part and its magnified image are viewed in the same



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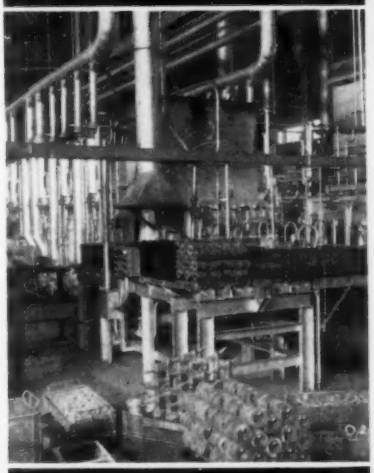

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Magnesium tooling plate can result in savings in your production operations. Its lightness, flatness, machinability and dimensional stability are ideal for fabricating accurate, easy-to-use jigs, fixtures, templates, gages, and for other tooling uses. For more information, write THE DOW METAL PRODUCTS COMPANY, Merchandising Dept. 1103FJ2, Midland, Michigan.

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FRanklin 1-0212
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KEystone 4-0586

THE DOW METAL PRODUCTS COMPANY

DOW

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TOOLS of today

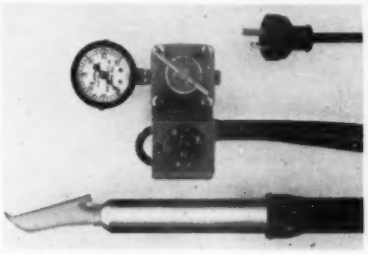
respective position. A screen holder accommodates adjustable sliding screens, making it possible to take all micrometer readings from zero as well as from quick check points. Pieces as large as 2½ inches in diameter and 4 inches in length or as large as 2 x 4 x 1 inch thick can be inspected.

When used as a toolmaker's microscope, the instrument is equipped with adapters for microscope tubes which may be furnished for interchangeable oculars. The conversion from comparator to toolmaker's microscope is done by replacing the projection lens with a microscope tube.

Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y. **Circle 416**

Welder Joins Plastics

All operations from tack welding to high-speed welding can be performed with Kamlar Model 12-AW welder. Designed for thermoplastics such as polyethelene, polypropylene, PVC and plasticized tank lining, this unit can be used for both shop and field work. Welding speed is 60 ipm. Supplied with a tacker



tip and one round tip, the welder has a three-heat element with an output to 800 watts. A metal-cased rotary switch, a pressure gage, an air-flow regulator and a 16-ft neoprene air hose are furnished. The unit can be plugged into any 115 volt a-c outlet.

Kamlar Products Co., 932R Washington St., Norwood, Mass. **Circle 419**

USE READER SERVICE CARD ON PAGE 183 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Skidless Pickups for Surface Measurements

Surfaces too small to permit using pickup skids and a diamond stylus in one location can be measured with one of three skidless pickup models. All three are used in conjunction with a precision slide—either Model BK 3922F

for HARDENING • BRAZING
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MELTING • SINTERING • WELDING
REFINING • SHRINK FITTING
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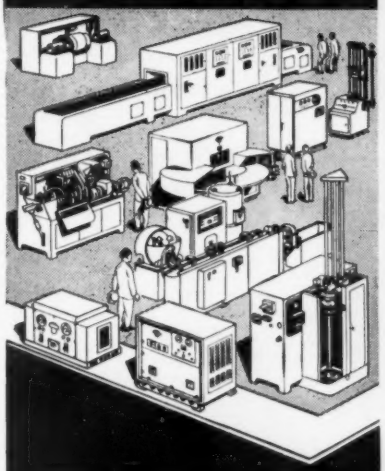

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Small compact couplings, PUSHOMATIC one-hand connect or disconnect. Automatic locking — high-pressure connection. Maximum flow.

- One-hand operation
- Automatic action
- Integral shut-off
- 360° swivel action

INTERCHANGEABLE

Interchangeable with all popular makes. Fast, easy one-hand "push" action connects or disconnects lines instantly.

- Interchangeable
- Automatic locking
- One-hand operation
- Full swivel action

STRAIGHT THROUGH

Full unrestricted flow. Same inside diameter as nominal pipe or supply hose. Sleeve action. Fast transfer of media.

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- Leak-proof
- Sleeve action
- Rugged construction

DOUBLE SHUT-OFF

Shut-off valve in socket and plug stops the flow from both lines when disconnected. One-hand operation.

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- Two-way check valve
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All disconnects available from stock in various metals, end connections and sizes. Write for Bulletin 1475.

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TOOLS of today

or BK 3922R and a power trace, Model BK 3911, which produces the movement of the slide. The slide generates the reference line normally provided by the skids. With this combination, stroke adjustments are controlled from lengths of trace from 0.005 to 1½ inches. Surfaces of less than one microinch can be measured by the equipment mounted on the surface plate.

Model MP 0002SL general purpose skidless pickup measures small internal and outside diameters, flanges, threaded flanks and gear teeth to within 0.02 inch of the shoulder. For measuring surfaces behind flanges or shoulders and groove bottoms, Model MP 6100SL groove bottom skidless pickup is used. Model BK 6101 roughness meter, with the addition of the precision slide and power trace, provides the third model.

Cleveland Instrument Co., 6220 E. Schaaf Rd., Cleveland 31, Ohio. **Circle 420**

Gear Shavers Have Improved Heads

With the new cutter head design used on the Red Ring gear shaving machines for finishing the tooth surfaces on spur and helical gears up to 18 inches pitch diameter, the shaving cutter nut is loosened or tightened with the outboard support bearing in place. This eliminates the possibility of bending the cutter shaft or hardening the bearings when tightening or loosening the cutter

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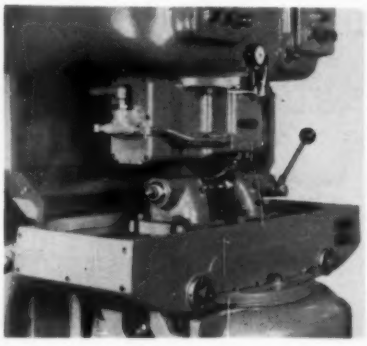


nut with a wrench. The cutter head, made in two sizes that accommodate either 9 or 12-inch-diam cutters, is utilized on Model GCU-8, 12 and 18-inch machines.

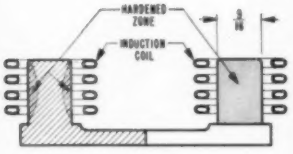
National Broach & Machine Co., 5600 St. Jean, Detroit 13, Mich. **Circle 421**

LepeL
HIGH FREQUENCY
Induction
HEATING
UNITS

Lepel induction heating equipment is the most practical and efficient source of heat developed for numerous industrial applications

Typical Induction Heating Applications

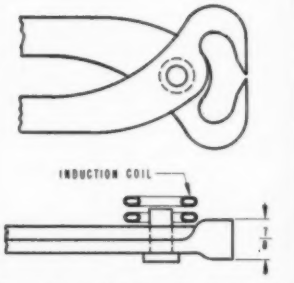
Steel Bosses Selectively Hardened



Bosses on part shown are locally hardened to increase resistance to wear and plastic yielding. Surface hardening by induction provides hardness pattern indicated and hardness of Rc 57/59 for 1040 steel when quenched in water.

Our engineers will process your work samples and return the completed job with full data and recommendations without cost or obligation.

Hot Forming Aids Production Assembly of Nippers



The ends of high-strength steel rivets are selectively heated to 1700° F for hot upsetting. Design of coil permits movement of upsetting tool through the coil.

WRITE FOR NEW LEPEL CATALOG
LepeL HIGH FREQUENCY LABORATORIES, INC.
55th ST. & 37th AVE., WOODSIDE 77, N. Y.
CHICAGO OFFICE: 6246 WEST NORTH AVE.

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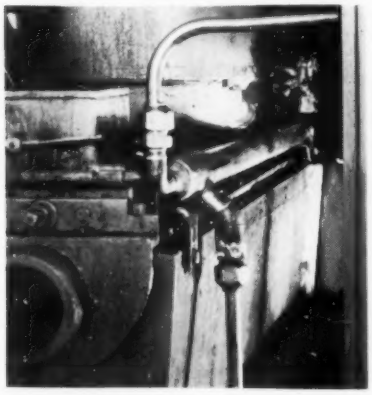
Humidifying Unit Extends Belt Life

Edge cupping and curling of coated abrasive belts in dry atmospheres can be prevented with this humidifier. A slotted copper tube having a 1¼-inch ID and a length as long as the belt is wide is mounted close to the back of the belt, bathing the belt edges with dry steam from the plant supply or a portable steam generator. The tube has two ⅛ x 4-inch slots. Inside the tube, a ⅜-inch copper tube of the same length

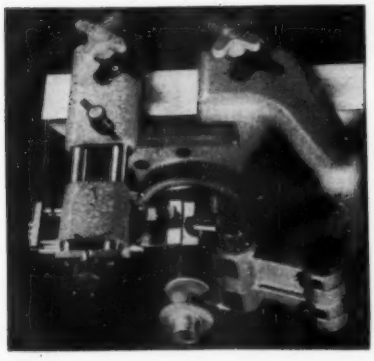


with a line of 1/16-inch holes on a ½-inch centers is centered so that the small holes are 180 deg from the slots in the outer tube. Steam is admitted to the small tube by a ⅜-inch fitting at one end. A drain is rigged from a copper tee at the same end of the outer tube. Condensate water, instead of reaching the belt, will collect in the bottom of the larger tube and flow out via the drain.

Behr-Manning Co., Troy, N. Y. **Circle 422**

Wheel Dresser for Complex Shapes

This spindle-mounted contour wheel dresser—Model SMD-704—is capable of dressing complex shapes in grinding wheels with accuracy measured in ten-thousandths of an inch. It is a 1:1 ratio template tracing model, designed to fit most surface grinders using a 7-inch-diam x 4-inch wide or smaller wheel. The mounting casting, bored to fit a 3-inch-diam spindle, can be sleeved down to fit smaller diameter spindles or can be bored to fit spindles up to 3.25 inches in diameter. Diamonds used in the wheel dresser may be of any shape or size as long as they enter the form being dressed. The feed knobs of the unit are graduated in 0.001 inch and each feed knob has a cam lock to secure its position after adjustment.



Tracaform Corp., 11380 Kaltz, Warren, Mich. **Circle 423**

High-Speed Drill Units

Spindle speeds from 800 to 15,500 rpm for the production of 0.02 to ¼-inch-diam holes are possible with these high-speed automatic drill units. They are complete with electric motor, traversing spindle and controls. Stroke length, advance and retract rate and spindle thrust are adjustable. Drilling speed is also adjustable in steps through selection of driving pulleys.

Two models are available—series 34 and 36. The series 34 is equipped with a complete electrical interlock circuit for actuating operations coordinated

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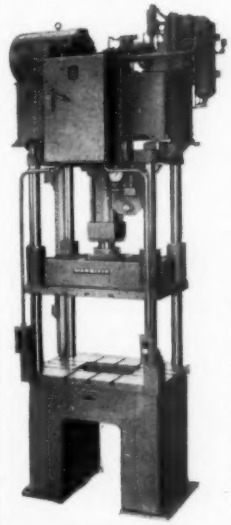
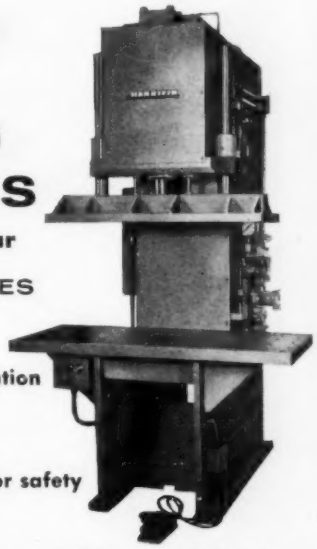
Give you more parts per hour

OPEN GAP OR COLUMN TYPES





- High speed operation
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- Complete operator safety
- 2 to 150 tons

Faster Speeds • Lower Prices • Quick Delivery

YOU GET THESE FEATURES:

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NEW JAR-FLO

LUBE-GRUV® TAPS

LUBRICATION GROOVES MAKE CHIPLESS FORMING OF INTERNAL THREADS AS EASY AS CONVENTIONAL TAPPING!

NOW, for the first time, cold forming taps that give *full time lubrication* to the *forming contact* area during the *full* tapping cycle.

LUBE-GRUV® gives you a *far superior finish* on the formed threads than is possible with conventional cold forming taps.

USE CONVENTIONAL TAPPING EQUIPMENT. The combination of *positive lubrication* and *narrow contact* surface makes the forming of internal threads much easier than with ordinary cold forming taps. Jar-Flo with LUBE-GRUV has less drag, requires less driving torque.

LUBE-GRUV® Jar-Flo TAPS FOR CHIPLESS FORMING INTERNAL THREADS IN DUCTILE MATERIALS—STRONGER THREADS—NO CHIPS—AVAILABLE IN PLUG OR BOTTOMING TYPES

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____Have Rep. call ____Rush LUBE-GRUV Brochure

Name _____ Title _____

Company _____

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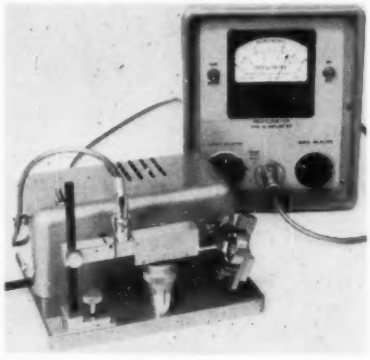
TOOLS of today

with other machines and equipment at the beginning or end of the drilling stroke. Other features of the spindle design of both series are a 0 to ¼-inch geared chuck and dynamic balancing which holds spindle runout to 0.0003 inch.

Dumore Co., 1300 17th St., Racine, Wis. **Circle 424**

Pilotor Checks Radius Roughness

Both reciprocating and continuous tracing motion are provided for the Profilometer type RE rotary pilotor, making it suitable for checking surface roughness of a wide range of parts. It checks surface roughness in microinches around surfaces of rotation and across the radii of small parts, both



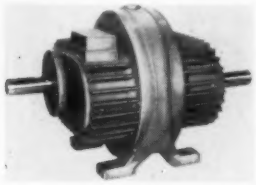
internal and external. Surfaces of rotation or radii from 1/32 to 2 inches can be handled easily with the pilotor. Any desired arc of trace from 10 to 350 deg, with automatic reversals, can be selected. This device is used in conjunction with a standard Profilometer amplimeter and tracer.

Micrometrical Mfg. Co., 3621 S. State Rd., Ann Arbor, Mich. **Circle 425**

Reversing Transmission for Automated Systems

Loads for industrial servo systems and automated systems using card or tape control can be positioned, sequenced and reversed in 0.2 sec with the Electromission. It consists of an input and an output shaft, connected through either a gear drive or a chain drive depending upon the status of two opposing electromagnetic clutches. Engaging one clutch provides chain drive for same-direction rotation of the output shaft compared to the input shaft. Engaging the other clutch produces gear drive for opposite-direction rotation of

the output shaft. When both clutches are disengaged, the transmission runs in a neutral position. The unit offers an output speed choice with differing forward versus reverse speeds available for normal advance and high-speed retraction of cutting tools. Rated 5 hp at 1750

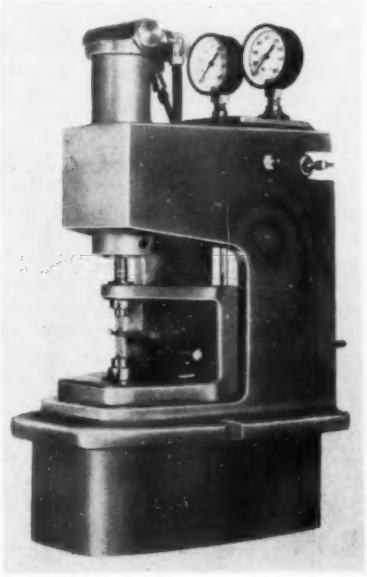


rpm, the unit is capable of transmitting torques in excess of 250 lb-in. under transient conditions while its capability under steady-state conditions at any desired speed is 180 lb-in. A 110-volt single-phase a-c power supply is adequate.

Airborne Accessories Corp., Hillside, N. J. **Circle 426**

Tool Makes Assembly Automatic

Three operations—pressing, staking and ejection—are combined in one fully automatic assembly tool. Independent pressing and staking forces adjust to taps up to one ton while an ejector re-



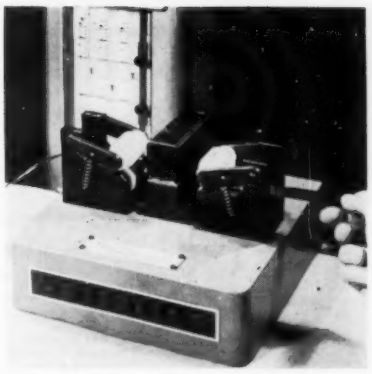
moves finished assemblies. It has a removable C-holder die set which adapts to a wide variety of assembly operations.

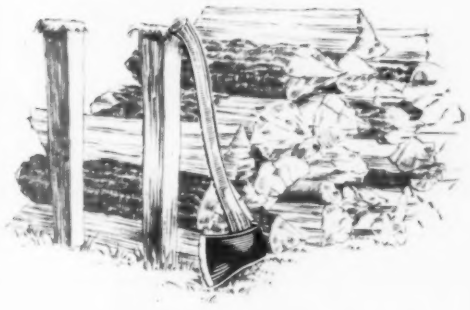
Cramer Controls Corp., Centerbrook, Conn. **Circle 427**

USE READER SERVICE CARD ON PAGE 183 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Air Gage Checks Strip Thickness

Continuous inspection of the thickness of thin strips of metal or other hard material within a total tolerance range of 0.0002 inch is possible with the Precisionaire noncontact air gage. It handles strips up to 1 inch in width ranging in thickness from 0.0027 to 0.062 inch by means of interchangeable riser blocks. The operator pulls the strip through the gage head which has three pairs of opposed airjets. Thus, thickness is checked at three points





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across the width of the strip. The float of the device rises or falls 2 inches within the tolerance range with gaging amplification of 10,000 to 1.

Sheffield Corp., Dayton 1, Ohio. **Circle 428**

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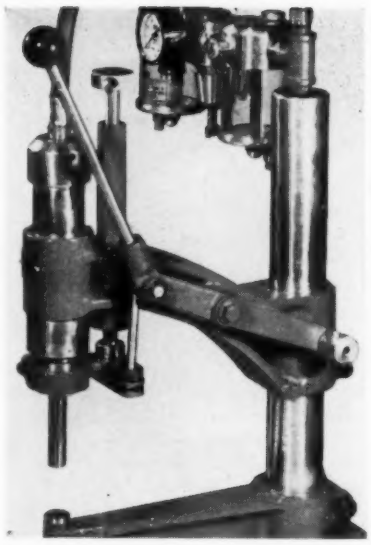
Pneumatic Hammer Rivets, Stakes

This bench mounted machine, Model 150-RHP-090, is a vibrating or repeating hammer with a 9-inch throat clearance and a horn type anvil. It operates by foot pedal or hand lever. One feature of the machine is that valving is internal and actuation is by contact pressure of the tool on the work. So long as contact pressure is maintained, the hammer will repeat, the rate varying from 3000 to 6000 times per min according to the air pressure used. The

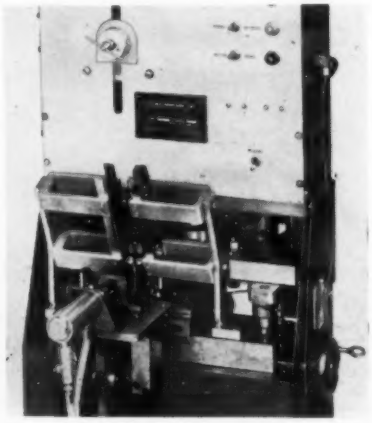


action may be regulated from a gentle vibration to a riveting capacity of ⅛ inch in mild steel. The machine can be used for riveting, staking, inserting bearings and bushings, parts assembling and for working and shaping sheet metal.

Heidrich-Nourse Co., 631 E. Third St., Los Angeles 13, Calif. **Circle 429**

Lead Straightener Is Fully Automatic

This automatic component preparation machine straightens both leads of capacitors, resistors and diodes and aligns them with the body of the component. The Auto-Straightener, Model AUS, handles all size bodies and straightens the component leads at 3000 or more parts per hour. A major feature of the machine is its ability to handle short run production also. Electrically controlled and pneumatically operated, the machine is available with a lead trimmer and a lead tapping accessory for coupling to other equipment by means of a rear discharge chute. It



A—Hardened Ways and Slides
B—Composite Die Sections
C—Heel Block
D—Center Clad
E—Flange Slide
A
A
A
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A
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B
C
D
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E
E
save
save
save with
OHIO KNIFE CO.
hardened ways and wear plates
NEW SHAPES—12 cross sections.
NEW USES—for dies, die sections, flange sections, ways, gibs, rails.
88 SIZES—every practical width and height up to 168" length.
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READY TO USE—delivered with cutting, forming, wearing surface machined, hardened and ground. Soft steel backing quickly drilled.
LOWER PRICES—production in large quantities enables us to price them below yours or other makes.
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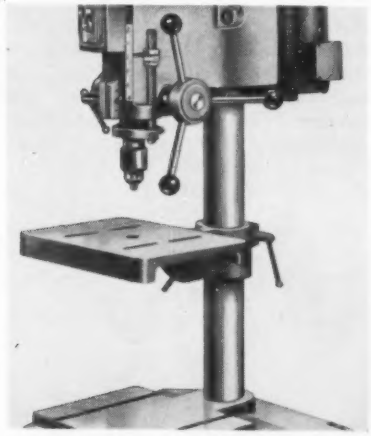
is equipped with toggle switches and signal lights for manual, pedal and automatic operation.

Design Tool Co., 1055 Stewart Ave., Garden City, Long Island, N. Y. **Circle 430**

Drill Press Has Large Capacity

This 15-inch general purpose drill press is offered in either a bench or floor model and with either a variable speed drive having speeds from 500 to 4500 rpm or a five-speed drive with speeds from 410 to 5380 rpm. It has a 3-inch-diam column, a 10 x 14-inch tilting table and a 10 x 13-inch working

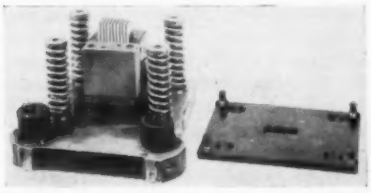


surface. Its spindle travel is 4¾ inches and it can drill to the center of a 15-inch circle. Floor models have a 41¾-inch spindle-to-table capacity and measure 47⅛ inches from the spindle to the base. Bench model capacities are 14¼ inches over table and 19⅝ inches over base.

Clausing Div., Atlas Press Co., 2317 N. Pitcher St., Kalamazoo, Mich. **Circle 431**

Quick-Change Punch Cluster for Slotting Dies

The Tru-Tex punch cluster and retainer unit, which uses standard blade perforators, can be incorporated into dies that pierce slots or louvers on close centers. The entire unit can be dismounted and sharpened as an individual component. If a spare punch and



Impossible Milling Problem Routine with B&S Engineered Cutters!

B&S CUTTER PERFORMANCE

Original attempts to produce the piece by grinding from solid and by other methods were unsatisfactory. B&S Cutter produced pieces for a fraction of the cost of grinding. Part quality and lead accuracy exceeded requirements.

EXTERNAL THREAD
PART: Locking shaft for hydraulic gate
MATERIAL: No. 135 Nitralloy heat treated to 295 BHN
MACHINING TIME: 45 minutes
CUTTER: B&S, 4P Acme Thread Milling Cutter
SPEED: Part 4/5 RPM, Cutter 96 RPM.
LENGTH OF CUT: 11 11/16"
PRODUCTION: 4 Pieces—3 hours of close tolerance, uninterrupted cutting per sharpening

B&S CUTTER PERFORMANCE

Previously, this internal thread was tapped with unsatisfactory results. B&S Cutter lowered time and cost of production and maintained a degree of part quality, uniformity and lead accuracy considered impossible.

INTERNAL THREAD
PART: Ram shaft for hydraulic gate
MATERIAL: A1S1 410 heat treated to 210-250 BHN
MACHINING TIME: 45 minutes
CUTTER: B&S 6P Acme Thread Milling Cutter
SPEED: Part ½ RPM, Cutter 200 RPM
LENGTH OF CUT: 3 1/64"
PRODUCTION: 3 Pieces—2¼ hours of close tolerance, uninterrupted cutting per sharpening

INDUSTRIAL DISTRIBUTION — THE RIGHT HAND OF PRODUCTION

Brown & Sharpe CUTTING TOOLS

NOTE:—

In addition to the production benefits engineered into every Brown & Sharpe Milling Cutter—Cutter Service Shops in strategic locations and cutter engineering in your plant are two other EXTRAS to expect when you specify B&S.

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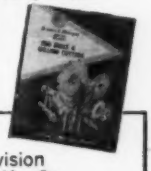

For that EXTRA Edge in Production!

Brown & Sharpe

Cutting Tool Division
Brown & Sharpe Mfg. Co.
Providence 1, Rhode Island

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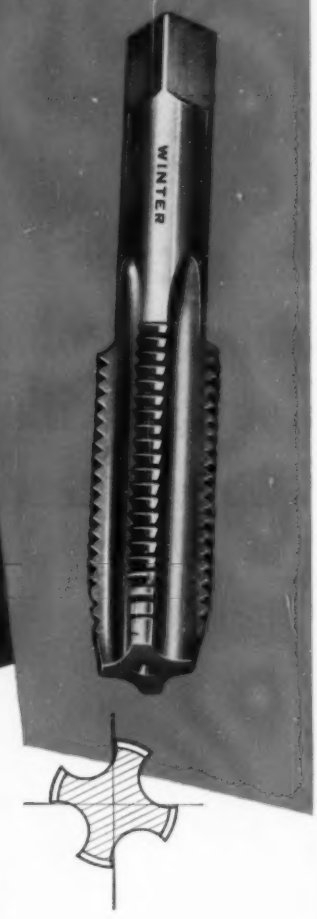
WINTER MULTI TAPS

for accurate tapping of soft metals



WINTER

Versatile Winter Brothers Multi Taps answer the need for a single, effective tool for tapping of soft or annealed aluminum, magnesium, stainless steel and some types of copper.

Specially surface-treated to retard abrasion encountered in these materials, Winter Multi Taps provide exceptionally long, accurate tool life that materially reduces cost-per-hole.

Multi Taps are designed and manufactured to famous Winter **Balanced Action** tool standards. Flute contours are absolutely uniform. Chip driver contours are of maximum precision. Exact flute spacing, plus rigidly-held accuracy and concentricity of chamfers, are your assurance of peak production tapping performance. Specify Winter **Balanced Action** Multi Taps the next time you order!

WINTER BROTHERS COMPANY **Rochester, Michigan, U.S.A.**

DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK CHICAGO • DALLAS • SAN FRANCISCO • LOS ANGELES

CHOOSE FROM WINTER'S WIDE LINE OF TAPS, DIES AND GAGES

CALL YOUR WINTER DISTRIBUTOR

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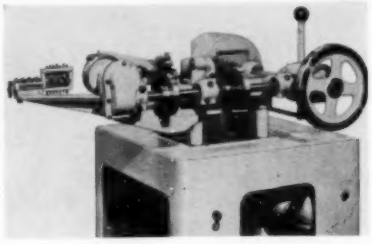
retainer assembly is included with each die, the die can be operated almost continuously, eliminating the need for a second die. There are no restrictions on the shapes of the holes that can be pierced with the unit—rectangles, squares, oblongs, and "obrounds" can be produced.

Tru-Tex Div., H & R Supply Co., Cincinnati, Ohio. **Circle 432**

Wire Straightener Cuts Off, Forms

While designed basically for wire straightening and cutting-off, the No. SC-00 straightening and cutting-off machine can be tooled to perform a variety of secondary operations, such as forming, heading, coining or piercing and winding. The machine is capable of straightening and cutting off short lengths of round wire up to 3 inches and in sizes up to 0.045-inch-diam basic

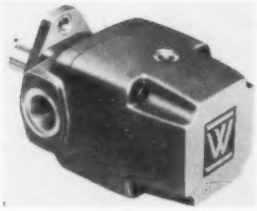


wire (to 0.060-inch soft material), or its equivalent in ribbon metal in widths to $\frac{3}{8}$ inch. Lengths are cut off at rates to 400 per min. Tolerance is held to ±0.002 inch on feed lengths and, using a secondary cut-off attachment, tolerance is maintained at zero. The machine can produce parts with square-cut, divergent-cut or a combination of these cuts on a given length or wire.

A. H. Nilson Machine Co., 1400 Bridgeport Ave., Shelton, Conn. **Circle 433**

Hydraulic Pumps Double as Motors

Fixed displacement axial type piston motors and pumps of four different capacities—series C3F—have displacements of 0.72, 1.09, 1.45 and 1.81 cir. Rated for continuous duty of 3000 psi and intermittent pressures to 3500 psi, the units produce capacities from 3.3 to 8.5 gpm at 1200 rpm and 5 to 14 gpm at 1800 rpm. Operating speeds are up to 2400 rpm, the largest unit delivering 18 gpm at this speed. Used as motors, these units have torque ranges of 11.52, 17.28, 23.04 and 28.80 lb-in. per 100 psi

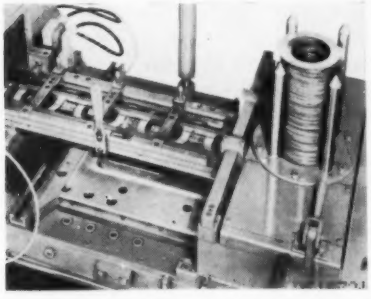


or output horsepowers ranging from 5.5 to 14 at 1200 rpm and 8 to 22 at 1800 rpm, operating at 3000 psi. The largest size, operating at 2400 rpm, can deliver 28 hp at 3000 psi. The pumps are large enough to handle 1-inch NPT inlet or 1¼-inch OD tubing thread. The side ports can be mounted either horizontally or vertically.

Webster Electric Co., Racine, Wis. **Circle 434**

Press Feeder Handles Blanks, Coil

Keeping a press running at top productivity is the function of the Flexofeed unit. Supplied only as an accessory component of the Flexopress, it feeds both cut blanks and coil strips. It handles a wide range of feed lengths

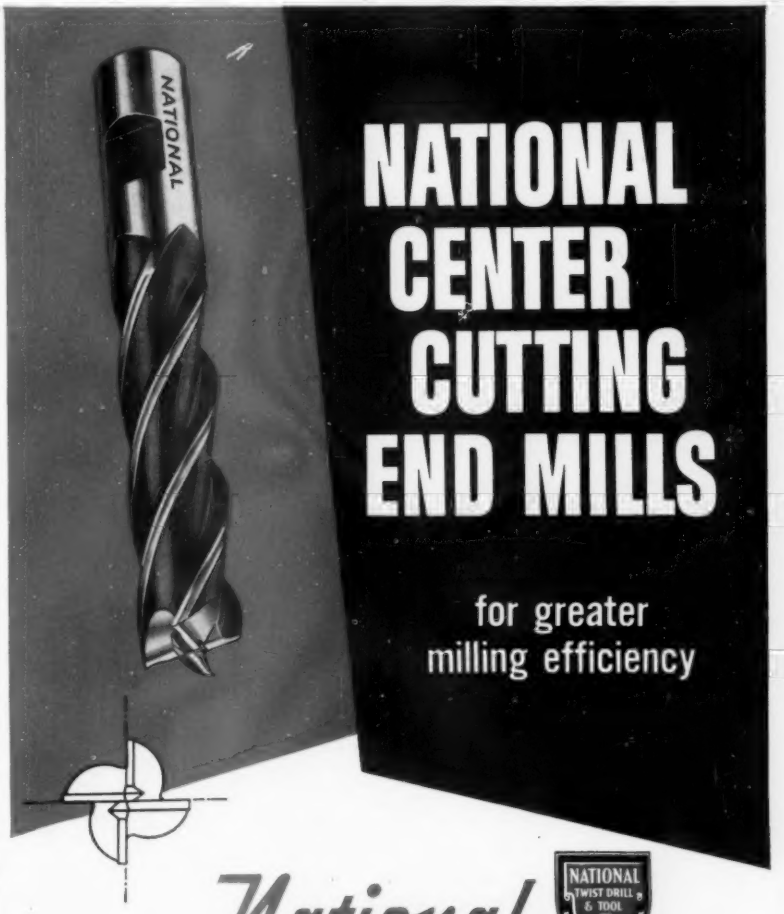


and speeds with accuracy to ±0.002 inch. It can feed coil stock to 2500 ipm and blank as many as 300 parts per minute. The unit, consisting of a frame, gearing and linkage, can be permanently mounted on the press.

Precision Welder and Flexopress Corp., Cincinnati, Ohio. **Circle 435**

Abrasive Belts for Concave Surfaces

Coated abrasive bands and belts which assume any desired degree of crown when run on inflatable rubber drums are suited for offhand work in confined areas and particularly on concave or other contoured surfaces. Their crowned shape eliminates the edge cutting that occurs when a flat band is inadvertently tilted, permits accurate grinding on extremely narrow areas and diminishes chattering when operated at low pressures. They are



NATIONAL CENTER CUTTING END MILLS

for greater milling efficiency

National

National Center Cutting End Mills can materially reduce costs on machining operations where both plunge cutting and traverse milling are required. Designed with teeth extending to the center of the tool, Center Cutting End Mills can initiate their own holes, then continue general milling of the workpiece without the need to change tools.

National Center Cutting End Mills are available in two popular series: "4300" for general purpose milling; "XM" series of specially-treated, premium steel for difficult-to-machine materials.

Center Cutting End Mills, as well as a complete line of conventional end mills, are stocked by your National Distributor. Call him today.

NATIONAL TWIST DRILL & TOOL COMPANY
Rochester, Michigan, U.S.A.
DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK
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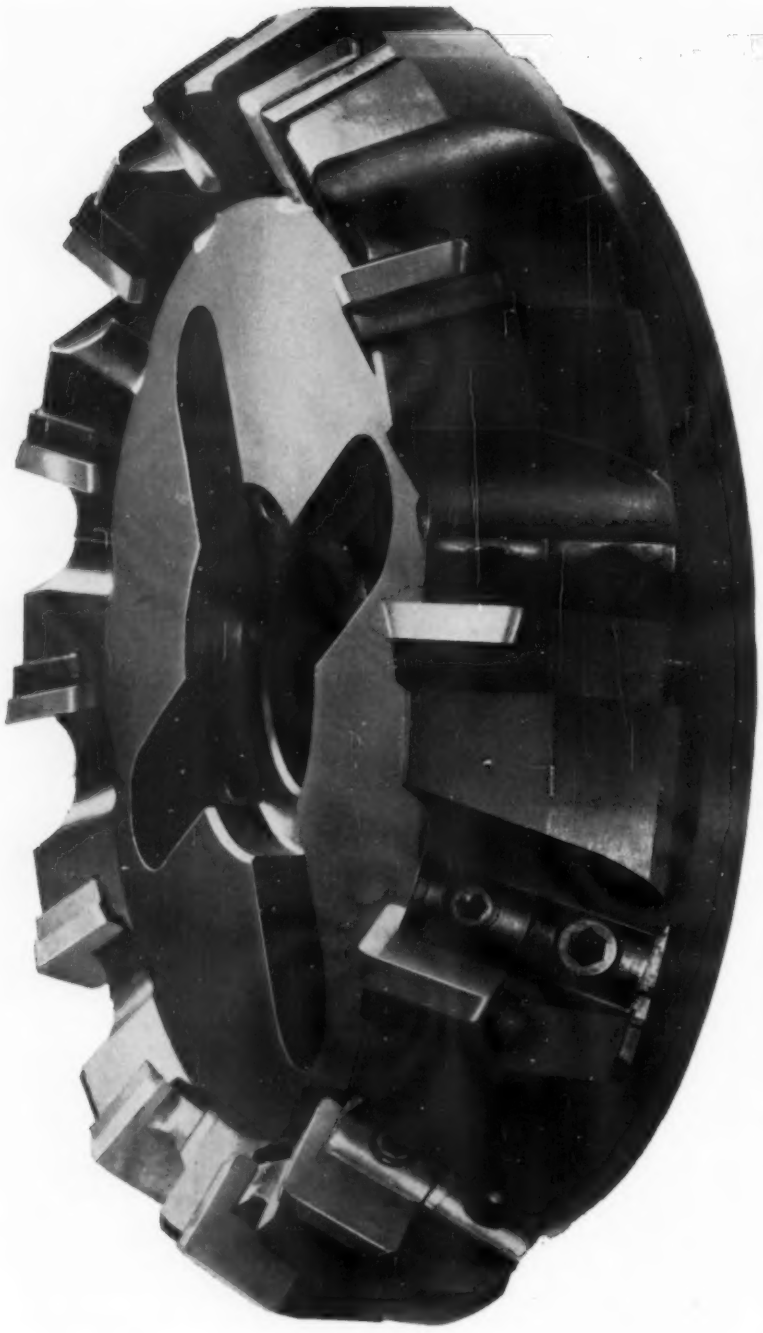

How efficient are Joydex cutters? We quote from a recent performance report: "Facing and rough milling a chrome-moly vanadium casting (Brinell 250) to a depth of ⅞" at cutting speed of 200 SFPM, the 12" dia. Joydex milled approximately 300 cu. in. per blade edge. Performance was beautiful."

Send for "Joydex" Catalog.

LOVEJOY TOOL COMPANY, INC.
Springfield, Vermont, U.S.A.

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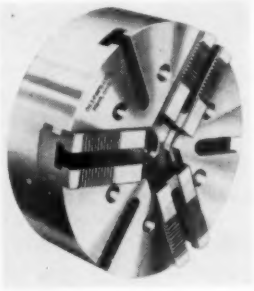
TOOLS of today

made of aluminum oxide abrasive in grits 40 through 180 on X-weight cloth, bonded with all-resin adhesives. Designed for use on smooth-faced or serrated drums, the bands are available in three sizes: 2 x 95⅛ inches for speeds of 6000 rpm; 2½ x 15½ inches for speeds of 4500 rpm; and 2 x 19 inches for speeds of 4000 rpm.

Behr-Manning Co., Troy, N. Y. **Circle 436**

Self-Centering Power Chuck

Available with two or three jaws, this 18-inch self-centering power chuck has flame-hardened ways that maintain the close fitting between master jaws and ways to insure longer life and to withstand the shock of increased speeds and heavier feeds. Maximum jaw travel of the chuck is ½ inch. The chuck is also available with a draw tube extension to



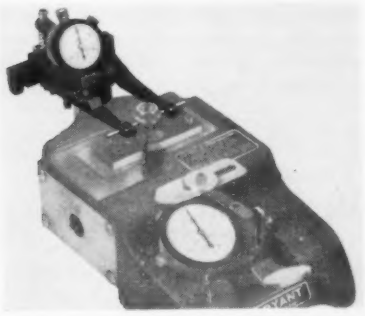
provide clearance for tools such as boring bars and reamers. A dust bushing, ground in place to keep out dust and metal chips, can be used as a pilot for a boring bar and for preventing bell-mouthing. This chuck has a special cam and lever design for greater gripping power.

S-P Mfg. Corp., 30201 Aurora Rd., Cleveland 39, Ohio. **Circle 437**

USE READER SERVICE CARD ON PAGE 183 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Thread Gage Attachment Checks Shoulder Squareness

Designed to check the squareness of faces and shoulders of parts in relation to internal or external threads or diameters of the part, the gaging segments of this thread gage attachment hold the part firmly on the flanks of the thread



in a manner similar to that of the mating part when assembled. Indicators read in either 0.0005 or 0.0001-inch graduations and accuracy and repeatability are within 0.0001 inch. The contact arms of the unit are adjustable horizontally to suit various face diameters.

Ex-Cell-O Corp., 945 E. Sater St., Greenville, Ohio. **Circle 438**

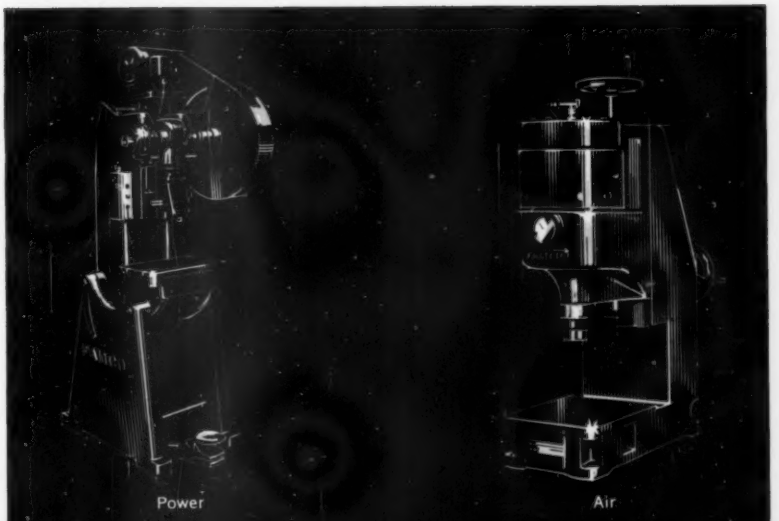
Quill Units Operate Threading Heads

Three self-contained quill type power feed units—Models 44, 46 and 410—are equipped with air-powered yoke actuators for opening and closing the threading heads at stroke end and full retract positions. Tripping and resetting forces of the yoke actuators are applied momentarily to minimize heat generating friction between yoke and collar. These units use compressed air for actuation and thrust, and have adjustable cam controls for establishing length of rapid travel. During feed, the thrust of the quill is balanced to allow the threading head to establish its own lead. Speeds from 150 to 1800 rpm and cycle rates to 45 per min are possible.

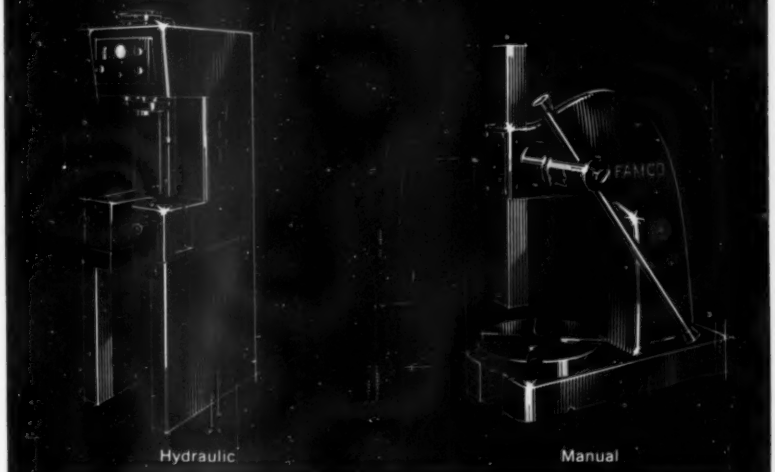
Hause Machines, Inc., Montpelier, Ohio. **Circle 439**

Horizontal Broach Has 60-inch Stroke

This horizontal broach—Model H 1560—has a capacity of 15 tons and up to 60 inches of cutting stroke. Fully variable cutting speeds to 22 fpm and to 60 fpm return stroke permits high-



Presses for any situation



Famco, the only press manufacturer that gives you so much selectivity. A press for any situation—air, power, hydraulic, manual.

Famco presses are quality! They defy maintenance. Their precision never varies, even under continuous pounding. They help you most, right where it's needed—in your pocket.

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KENOSHA, WISCONSIN

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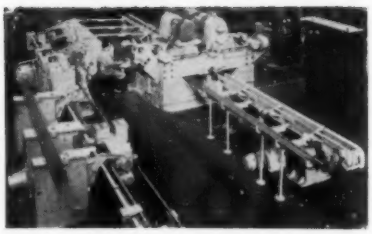
speed production. Features of the machine include a fully adjustable pull head, a 10-inch face plate opening, a chip pan coolant receiver and a separately motorized coolant system. Power equipment included are a 10-hp main hydraulic motor, a ½-hp coolant pump motor and all switches and electrical controls. The hydraulic oil reservoir and coolant reservoir are located in the base of the machine.

Pioneer Broach Co., 6434 Telegraph Rd., Los Angeles 22, Calif. **Circle 440**

Turning, Straightening and Polishing Machine

Completely automatic operation is possible with this centerless bar turning, straightening and polishing machine. Made in several sizes, the machine removes the rough skin from the bars and turns them into bright bars of finished size. The peeled bar is transported into the straightening and polishing machine by means of an automatic leading and discharging device. The machine is fitted with two independently driven, vertically arranged



straightening tools, one on top of the other. The top roll is raised and lowered by a motor. The angle of the straightening rolls is adjustable.

Straus-Artys Corp., 45 N. Station Plaza, Great Neck, N. Y. **Circle 441**

ILLUSTRATED:
Speedgrip No. 3 Standard Straight Shank Mandrel, with hardened steel collet bushing.

SPEEDGRIP
EXPANDING MANDRELS

. . . are made from high grade alloy steel, heat treated; ground to precision gauges. Threads are ground after heat treating — assuring true perfection with the axis of the mandrel. Precision processing, combined with rigid inspection standards, give *Speedgrip* users maximum accuracy in their work parts. Many other advantages:

• Extremely simple design • Holds between centers or drives from taper shank • Holds diameters concentric and faces parallel within .0005 • Positions work parts longitudinally, quickly and accurately • Wide range of bore sizes accommodated by one mandrel • Safe and speedy operation • Full range of standard collet bushings available from stock • Modest price • Prompt shipment • Guaranteed

Write for complete information. Ask for bulletin 26.

SPEEDGRIP CHUCK Division of ERREST, HOLDEMAN & COLLET, INC., Elkhart, Indiana

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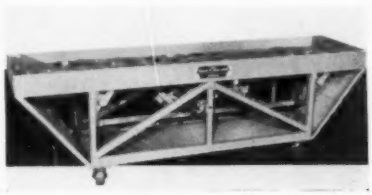
Transfer Table Handles All Parts

With a table top consisting of a fixed grid of longitudinal steel bars alternated with a moveable grid of steel bars, this portable transfer unit can be used to convey parts of almost any size and shape, and can also act as a mobile storage unit. Air cylinders raise, advance and lower the movable grid. The transfer table will handle parts ranging from



light plastic to steel castings of several hundred pounds with no adjustments. Air consumption during an 8-hr shift is equivalent to the amount of air exhausted from an air line open for 30 secs. The table requires no electrical connections.

Gear-O-Mation Div., Michigan Tool Co., 7173 E. McNichols Rd., Detroit 12, Mich. **Circle 442**

Gear Chassis Gives Infinite Ratios

Any mechanism where gear ratios must be quickly changed or where a specific gear train has to be assembled quickly can use the Versa Gear. With this chassis, it is possible to obtain an infinite range of ratios. Precision instrument gears are mounted with setscrews on both ends of a shaft which rotates in a ball-bearing housing. Housing and gears can be moved along a

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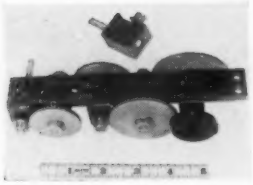


track that keeps the shafts properly aligned for accurate mating of gears with other gears in similar housings. Its applications include measuring repetitively any linear distance when driven by a measuring wheel of known circumference or any time interval when driven by a small synchronous motor.

Foster & Allen, Inc., Chatham, N. J. **Circle 443**

Turret Lathe Has One Motion Control

One motion control is the major feature of this 60 series turret lathe. A single lever starts the lathe spindle and selects any speed up to 4800 rpm. The same lever will change speed during operation or stop or reverse the spindle. A pushbutton on the knob of the lever

opens and closes the collet or step chuck. Stops may be set for repeating selected speeds. Reversing is instant, which makes it possible to quickly retract taps and dies.

Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass. **Circle 444**

Relief Valves for Machine Hydraulic Systems

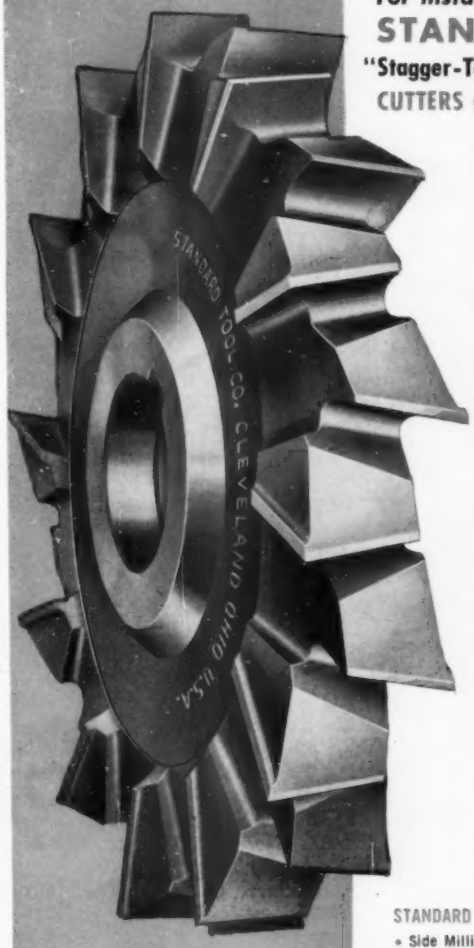
These pilot operated relief valves, for machinery hydraulic systems, have a minimum 5:1 safety factor over rated operating pressure. The line mounted type valves are for 3000 psi systems while the gasket mounted units are rated at 5000 psi. Both series are provided in rated capacities of 20 to 50 gpm. Their square body permits them to be mounted in any position. The valve opening pressure is controlled by the adjustable pilot valve. The adjustment control can be installed in any of four positions relative to the valve for easy accessibility.

Parker-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, Ohio. **Circle 445**

MORE metal removed at LESS COST.. Standardize with STANDARD'S Quality!

For instance . . .
STANDARD'S "Stagger-Tooth" ROTARY CUTTERS are designed with . . .

alternate right and left spiral teeth for improved deep-slot milling!



• BALANCED CUTTING ACTION of staggered teeth allows heavier cuts for smoother machining of tough materials.

• Tooth design provides extra space for BETTER CHIP CONTROL!

• STANDARD'S Quality assures LONGER TOOL LIFE, KEENER CUTTING EDGE!

STANDARD Cutters meet job requirements:

- Side Milling Cutters
- Plain Milling Cutters
- Heavy Duty . . . Regular
- Form Relieved Cutters
- Helical Plain Cutters
- Key Seat Cutters
- Slitting Saws
- Screw Slotting Cutters

DEPEND upon STANDARD'S Authorized Distributors . . .
For Twist Drills, Reamers, Taps, Counterbores, End Mills, Milling Cutters, Hobs, Gages, Dies, Carbides (solid or tipped) . . . and for Engineering or Technical Information.

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You can be sure of Uniform Performance from O-M Cylinders

Internal Key Tie-Rodless Type Series 101A. Air—150 psi—up to 1500 psi Hydraulic. Fits where others won't. Bulletin 101A.

Whether you operate O-M Cylinders, of the same psi rating, bore and stroke, singly or in sequence, each one will exert the same force, handle the same work load, with the same precision. In addition, the direction of each stroke, length of each stroke as well as the time interval between cycles will be controlled to the same high degree of accuracy. As all parts and mounts of O-M Cylinders, of the same capacity, are micro-honed or accurately machined to the same close tolerances, they are interchangeable and precise. Uniform operation is automatic.

O-M Cylinders are available in a complete range of sizes (1½" to 8" bores) with standard or heavy-duty rods. Complete line of interchangeable parts and mounts. Immediate delivery on most sizes.

Coupon below will bring our latest bulletins showing construction and dimensional details, engineering drawings, capacity chart and mounting data for each O-M Air and Hydraulic Cylinder. MAIL COUPON TODAY for your copies.

Bulletin 101A for Internal Key Tie-Rodless type Air and Hydraulic Cylinders featured above.

Bulletin 105A—Improved Tie-Rod (Heavy Duty) Cylinders Hydraulic 2000 psi; 3000 psi non-shock.

Bulletin 107—Automation (Heavy Duty) Air Cylinder for 200 psi operation.

Bulletin 108—Automation (Heavy Duty) Hydraulic Cylinder—for 1000 psi operation.

ORTMAN-MILLER MACHINE COMPANY
13 143rd Street, Hammond, Indiana

Send Bulletins
☐ Have representative call ☐ 101A ☐ 105A ☐ 107 ☐ 108

Name_____ Position_____
Company_____
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City_____ Zone___ State_____

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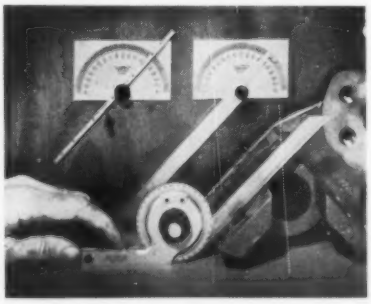
TOOLS of today

Protractors Are Easily Read

No-glare satin-chrome finished bevel protractors, steel protractors and protractor-depth gages are easy to read and have high resistance to corrosion and wear. The No. C359 series bevel protractor, available with 7, 12 or 7 and 12-inch blades, has this finish on the protractor dial and vernier. Other surfaces, except the blades and acute



angle attachment, are bright chrome.

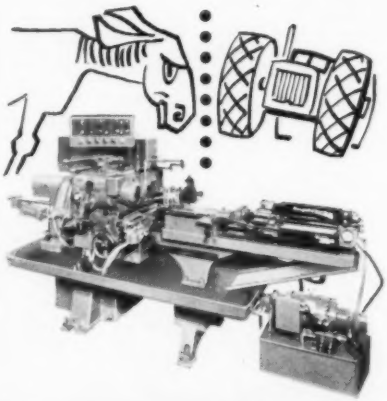
The No. C359 bevel protractors with vernier adjustment and acute angle attachment measures angles as close as 5 min or 1/12 deg. Similar to No. C359 is the No. C364, except that the latter doesn't have the fine adjustment feature. The satin-chrome finish is also available on the protractor head and blade of the No. C483 steel protractor and the No. C493B protractor and depth gage.

L. S. Starrett Co., Athol, Mass. **Circle 446**

Arc-Plasma Gun Sprays Part Interiors

Less than 2 inches long and 1½ inches in diameter, this 25 kw arc-plasma hand spray gun makes possible the spraying of materials onto hard-to-get-at surfaces. The 1-lb gun has been used successfully in spraying corrosion resistant and high-temperature coatings on the interior walls of small rocket nozzles, cylinders and chambers. It has

Transform your stubborn mule to a prime mover



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TURRET LATHE AUTOMATION
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HYDRIVE

Hydrive transforms older turret lathes from limiting factors to high volume producers! Technical management is being stimulated to machine tool re-evaluation in view of the proved success of automating turret lathes with Hydrive. Stepping up manual turret lathes to automatic operation—easily capable of tripling output—will multiply your capacity at surprisingly low cost. Without the substantial expenditure of new equipment, management reaches increased production goals . . . with wanted accuracy and reliability.

Write today for complete Hydrive information . . . how Hydrive will make your turret lathe far more productive. Also available upon request, FREE Hydrive film.

ACME INDUSTRIAL COMPANY
210 North Laflin, Chicago 7, Ill.

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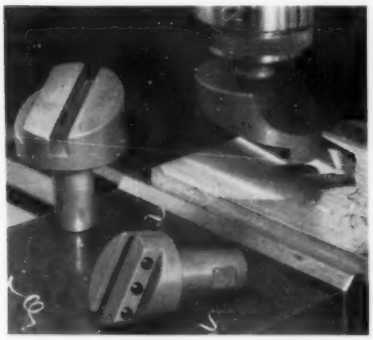
an operating efficiency of more than 60 percent. Electrode life is 200 hours when used with argon.

Plasmadyne Corp., 3839 S. Main St., Santa Ana, Calif. **Circle 447**

Flycutter Holders Fit Most Machines

Cuts up to 6 inches wide can be made in one pass with the Fli-Kut. This model has a counterbalanced holder for 5/16-inch carbide or high-speed tool bits. Because of their 3/4-inch shank size, these



fly tool cutter holders are adaptable to most vertical mills. They are made of hardened steel and are furnished in a set of three different sizes.

City Tool-Die & Mfg. Co., Inc., 132 Spencer Ave., San Jose 10, Calif. **Circle 448**

Subminiature Switch Has Short Travel

This subminiature switch is capable of maintaining a differential travel within 0.001 inch. It has 0.003-inch minimum overtravel and a 0.008-inch minimum break travel. Operating force for the switch is 3½ oz. Electrical rating is 30 volts with 3 amp inductive, 5 amp resistive and 24-amp maximum inrush. The UL listing is 5 amp at 125 or 250 volts a-c. The switch is designed for temperature or pressure control for electronic or instrument applications.

Minneapolis-Honeywell Regulator Co., Freeport., Ill. **Circle 449**

Building-Block Drilling Machine

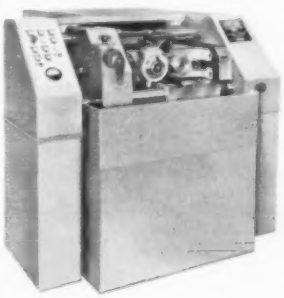
Ease of setup; pick-off change gears; and a broad range of speeds, feeds and tap leads make the series A two-spindle drilling and tapping machine suitable for small lot or production runs. Two

REED ROLLED THREAD DIE CO.

High Speed-
Thread Rolling Machine

Up to 200 Pieces Per Minute
with cylindrical single revolution dies

The Reed B910 Cylindrical Die Thread Rolling Machine is a rugged general purpose two-die type machine for high speed production. This machine is adaptable to a wide range of work using single revolution dies where the parts are rolled within one revolution of the dies. Diameters 3/16" through 1" and thread lengths up to 6½" long may be rolled.



The machine is simple to set up and convenient to operate. Both semi- and completely automatic work-handling equipment is available to take full advantage of the high production capabilities of the machine.

Write for Machine Bulletin B-150-1

REED ROLLED THREAD DIE CO.
Specialists in Thread and Form Rolling Tools and Equipment
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B-150-1

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the ACCURATE WAY to test MICRO and MACRO hardness

Wilson TUKON hardness tester

•Wilson TUKON testers make and measure extremely shallow indentations. They are used, for example, by manufacturers of watches, hairsprings, needles and jewels. In laboratories, TUKON instruments test individual crystals or microscopic particles. On any job, they provide these important advantages:

Accuracy—Precision-built TUKON testers give consistently correct results. Loads are applied without friction or impact—Bausch & Lomb optical equipment is standard—vibration is closely controlled.

Long life—Simple design, rugged construction make TUKON testers as durable as a machine tool.

Easy operation—Even an unskilled operator can get perfect readings after a short training period.

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A complete line of Wilson Rockwell instruments is available, including semi and fully automatic models.

Wilson "Brale" Diamond Penetrators Each diamond is cut to an exact shape. A comparator check and microscopic inspection of each diamond assure perfect readings every time.

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American Chain & Cable Company, Inc.
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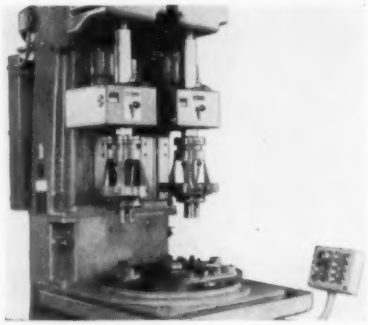

or more columns can be mounted on the base and rotary type index tables are used. A complete cycle is obtained at all stations simultaneously by depressing a pushbutton. The machine is constructed on the building-block concept.

Cleereman Machine Tool Corp., 7350 W. Lawrence Ave., Chicago 31, Ill. **Circle 450**

High-Speed Machine Straightens, Cuts Wire

Wire ranging in diameter from 1/16 to 1/8 inch can be straightened and cut with the Shuster LV18 variable speed automatic machine. It has infinite feed ranges from 25 to 150 fpm. The machine is designed for high-speed cutting —12,000 cuts, up to 8 inches long per hr. It is available in four models, one of which is a constant speed machine geared to feed up to 125 fpm.

Mettler Machine Tool Inc., Boulevard Industrial Pk., New Haven 4, Conn. **Circle 451**

Adhesive Bonds Metal, Paper

Combining the advantages of film adhesives with the self-filleting properties of epoxy adhesives, this high-strength supported epoxy resin film adhesive bonds metal and paper honeycomb cores to metal facings in honeycomb sandwich construction. Properties of the Scotch Weld AF-106 adhesive include shear

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strengths over 2000 psi at 75 F, high strength over a service temperature range of −67 to +300 F, good peel strength, high creep resistance under constant stress and good adhesion to metals and plastics.

Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. **Circle 452**

Men at Work

Herbert H. Howell's election as a vice president of Arthur D. Little, Inc., was recently announced. He will continue with his administrative responsibilities in ADL's engineering division. A graduate of the Massachusetts Institute of Technology, Howell joined the firm in 1950 after working five years with the Wright Aeronautical Corp. and two years at John Hopkins University.

Robert M. Gordon has been appointed executive vice president of the Milford Rivet & Machine Co. Gordon, for the last three years, has been vice president in charge of sales. Prior experience has been with the Penn Rivet & Machine Co. in manufacturing and engineering capacities and with the Torrington Mfg. Co., as sales manager of the air impeller division.

New manager of the special products department of Air Reduction Sales Co., Union, N. J., is J. H. BERRYMAN. Concurrent with Berryman's promotion was the appointment of ROBERT A. STONE as sales manager of the same department. Berryman will be responsible for the development of products and processes in the areas of custom-built welding and cryogenic and gas handling equipment from the research stage to its application for commercial and industrial purposes.

Herman A. Nunnemacher has been elected president of the Galland-Henning Mfg. Co. He succeeds his father, Henry J. Nunnemacher, president since 1917, who becomes chairman of the board. Nunnemacher has been with the firm since 1937. He graduated from Marquette University in 1936.

H. J. ELIAS has been named manager of signal diode manufacturing in General Electric Co.'s newly formed signal diode project in its semiconductor products department in Syracuse, N. Y. Immediately prior to his promotion, Elias was manager of quality control for the department's Syracuse plant. Elias will be responsible for all phases of the project's manufacturing operations including shop operations, quality control, manufacturing engineering and materials selection and procurement.

ERWIN M. KOERITZ was recently appointed manager of manufacturing, metallurgical products department, General Electric Co., Detroit, Mich. Prior positions have been as manager of manufacturing engineering in the silicone products department and supervisor of process engineering.

Fluid Power Div., Hale Fire Pump Co., Conshohocken, Pa., has recently appointed RONALD R. RESSLER as accumulator and fluid power development and application engineer. A graduate of Drexel Institute, he was formerly with the Burroughs Corp. research center, Paoli, Pa.

The promotion of William J. Fath to director of manufacturing has been announced by the Hydraulic Press Mfg. Co. Fath, prior to his association with H-P-M, held manufacturing positions with E. W. Bliss Co. and Fruehauf Trailer Co. He joined H-P-M in 1954 as production control manager. He has also served as works manager.

RENDALL E. HOLLAND has accepted the position of southwest manager of the American Drill Bushing Co. He is located in Dallas, Texas.

Newly elected president of Olympic Products Co., Inc., is Charles A. Volz, Jr. Formerly vice president and general manager, Volz succeeds Joseph B. Schaefer, who will become chairman of the board of directors. Volz has been with Olympic since 1948 and has served in several engineering and sales capacities. He was also employed by J. T. Baker Chemical Co.

Edwin W. Zipse has been elected president and chief executive officer, succeeding Konstantin Kronwall, of United-Greenfield Corp. Zipse, who has been associated with the company for 35 years, has served as executive vice president, as a director since 1951 and a member of the executive committee since 1958. Jack C. Malugen will move up to Zipse's former position.

Men at Work

GEORGE F. MARRIOTT has been named superintendent of the Indianapolis, Ind., plant of Jones & Laughlin Steel Corp.'s stainless and strip division. He was formerly superintendent of rolling and pickling, also at the Indianapolis plant.

Lockheed Aircraft Corp., Sunnyvale, Calif., has appointed WILLIS M. HAWKINS a vice president. The second corporate officer assigned to the missile and space division, Hawkins will remain as an assistant general manager of the division.

Magnetics, Inc., has announced the promotions to vice president of the company's four operating directors. The new vice presidents are J. C. BRANDON, JR., engineering; ROBERT W. OLMSTED, marketing; CHARLES B. WAKEMAN, research and development; and ELMER B. KAELIN, manufacturing.

Missile Systems Corp., Los Angeles, Calif., has appointed JAMES E. UPFIELD a member of the company's board of directors. Upfield is president of the Emtex Div.

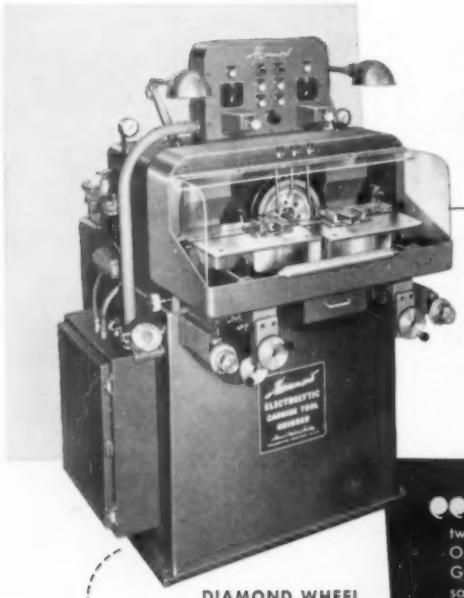
ROBERT G. PETERSON has been appointed to the newly created position of assistant chief engineer of the hydraulics division of Racine Hydraulics & Machinery, Inc. He will supervise the product engineering laboratory along with performing his duties as a hydraulics engineer.

DONALD E. GARR has been named corporate director of engineering for Raytheon Co., Waltham, Mass. To accept this position, Garr has resigned as manager of engineering operations for General Electric Co.'s armament and control section. Appointed to the post of engineering manager of the company's receiving tube operations was EMIDIO A. DELOLLIS. DeLollis will direct design and specification, product development, production engineering and engineering services.

New engineering projects administrator for Schaevitz Engineering, Pennsauken, N. J., is LOUIS D'ANGELO. D'Angelo, previously having been associated with the Philco Corp. and with Vertol Aircraft, will supervise all aspects of projects administration and cost control functions.

Appointment of BENJAMIN W. HUBBARD as sales engineer on automated special machine tools is announced by Snyder Corp., Detroit, Mich. His previous position was chief sales engineer.

Elwood F. Knapp has been named vice president of manufacturing and a member of the board of directors of Firewel Co., Inc., a wholly-owned subsidiary of Aro Equipment Corp. He will supervise manufacturing, development engineering, quality control and purchasing. Knapp joined the company in 1959 as plant manager. Since then he has been manager of the Cleveland plant, production engineer and chief engineer.



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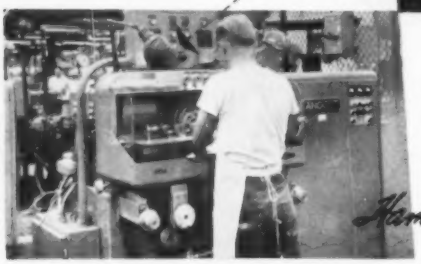

. . . Another dollars and cents success story for Hammond Electrolytic Grinders! If you, too, are after IMPORTANT savings in carbide tool grinding, take this simple step now: Send us a few single point tools to be ground. They'll be returned promptly with a "processing and time required report." No obligation.

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Link-Belt Co. has established an international division with headquarters in Chicago with Donald E. Thal as general manager of the new division. Thal, with 24 years of service with Link-Belt, has been general manager of its Pacific Central Div. and has held various management positions in engineering, sales and manufacturing administration.

LEROY E. BONNETTE has been named director of engineering for Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio. He will be responsible for the coordination of all company engineering activities. He has been associated with Denison in various capacities including research engineer, senior project engineer, chief development engineer and chief engineer.

Hunter Spring Co., a division of American Machine & Metals, Inc., Lansdale, Pa., has announced the appointment of WALTER E. BLANKLEY as field engineer serving upstate New York and adjacent counties of western Pennsylvania. Blankley will provide technical service for the company's line of precision springs and handle force measuring and testing equipment.

JOHN G. MORGAN has been appointed manufacturing manager of Hupp Aviation Div., Hupp Corp., Chicago, Ill. Morgan joined Hupp as product design engineer and subsequently became project engineer, quality-control manager, chief tool designer and chief manufacturing engineer.

The appointment of JAMES A. GRAHAM as general manager of the Bearings Co. of America Div. has been announced by Federal-Mogul-Bower Bearings, Inc., Detroit, Mich. Graham succeeds J. A. McCarthy, who resigned as head of the Lancaster, Pa., ball bearing manufacturing unit. Graham is the former manager of two SKF manufacturing plants in Philadelphia.

ROBERT R. COSNER has been named plant manager of Ford Motor Co.'s chassis parts plant in Sterling Township, Mich. Cosner, successor of John A. McCabe, joined Ford in 1954 as controller of the former Mound Rd. plant.

A series of top level appointments in Ford Motor Co.'s recently established automotive assembly division have been announced by D. J. Bracken, the division's general manager. D. J. BASTIAN, formerly manager of Ford's Los Angeles assembly plant, was appointed plant operations manager in charge of the division's 17 assembly plants, trim plant and pilot plant. G. J. FISCHER, formerly assistant controller of Ford, was named divisional controller and JAMES KNOWLES, formerly executive assistant to the vice president of manufacturing, was appointed quality control manager. Other key appointments were J. F. RANDALL, manufacturing engineering manager; J. S. CANTERBURY, material control manager; S. A. CORNELL, administration manager; and D. D. LENNOX, facilities planning.

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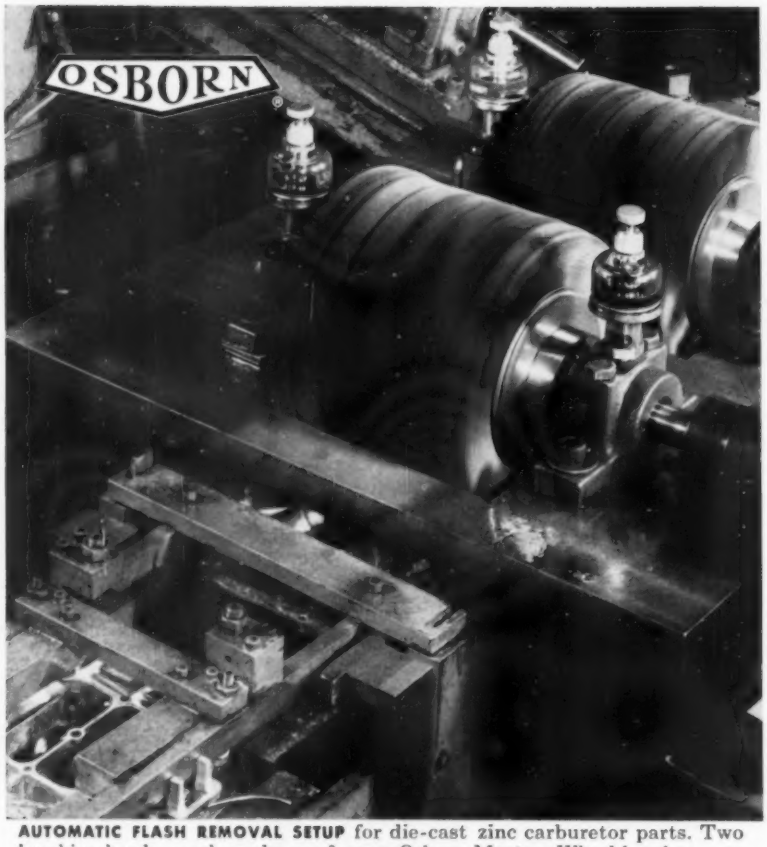

AUTOMATIC FLASH REMOVAL SETUP for die-cast zinc carburetor parts. Two brushing heads—each made up of seven Osborn Master® Wheel brushes—are mounted over the conveyor. Parts (shown fixtured in lower left corner) pass under brushing heads where all flash is removed as they travel to next work station.

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ENGINEERING BOOKSHELF

MEHRSPINDEL AUTOMATEN—*By Hans H. Finkelnburg. Published by Springer-Verlag, Berlin/Goettingen/Heidelberg. Price: German Mark 49.50. 315 pages.*

Printed in German, this book discusses the application of multiple-spindle automatic screw machines as compared to lathes, turret lathes and other single-spindle machines. The larger part of the book is devoted to multiple-spindle machines of two types: those in which the workpiece moves, and those in which it is stationary. Scheduling, preparation and presentation of operation planning are also discussed with full consideration given to machining costs. All examples cited refer to machines of American as well as European origin.

A valuable guide for tool and manufacturing engineers, this book will also be helpful for those contemplating purchase of multiple-spindle machines. It is recommended to all who are interested in automatic screw and chucking machines.

Dr. M. Kronenberg
Consulting Engineer
Cincinnati, Ohio

ENGINEERING MATERIALS HANDBOOK—*Edited by Charles L. Mantell. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $21.50. 2000 pages.*

Because the range of useful engineering materials has expanded significantly in recent years, the appearance of this book is particularly timely. Divided into 43 sections, each of which was prepared by one or more specialists, it discusses physical and chemical properties and applications of virtually all modern engineering materials. Processes incidental to their use such as casting, forging and heat treatment are also discussed. As an example, enameling of castings by both the wet processing and dry processing methods is covered. Block diagrams are used to aid the reader in following each process from initial metal fabrication to final firing. Specific design recommenda-

tions for sheet metal parts or castings which are to be coated are supplemented with additional information on subsequent processes such as welding and assembling. Finally, readers desiring additional information on either technique are referred to books, bulletins and magazine articles which treat this subject. These references—given at the close of the article—are supplemented by section 43, which includes a "source on sources" of information.

This typifies the approach to engineering materials used throughout the book. Because of its extensive coverage of materials this book will be found useful to readers in all branches of the engineering profession.

AIRCRAFT AND MISSILE DESIGN AND MAINTENANCE HANDBOOK—*By Charles A. Overby. Published by The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price $9.75. 369 pages.*

Consolidating technical data from hundreds of sources, this book contains over 160 tables and 40 figures to illustrate the standard methods of equipment installation and maintenance. Chapters are given to electrical and plumbing systems, materials of construction, aircraft and missile hardware, color codes and conversion systems, and processes such as metal spraying, anodizing, rust-proofing, plating, welding and brazing.

The text includes an explanation of standards, and gives many "tips" on proper handling of materials and tools. This book will prove useful to mechanics, inspectors, draftsmen, supervisors, designers, engineers working on flight vehicles.

EFFECTIVE WORK MANAGEMENT—*By Milon Brown. Published by The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price $5. 246 pages.*

Written as a basic primer of management, this book provides information designed to increase the reader's managerial skills. Viewing management as a cycle of control, the author divides this function into five basic processes: Planning, Organizing, Directing, Coordinating and Controlling.

The first five chapters describe the basic managerial function, explaining the interaction of these processes within the management cycle. In the remainder of the book, the processes are described separately and in detail. The final chapter is dedicated to management of tomorrow and the manner in which executive leadership is changing and will continue to change. The eventual goal: increased effiency, a more complete understanding with employees at all levels, and a more satisfying business life for the executive himself.

NONDESTRUCTIVE TESTING IN THE MISSILE INDUSTRY—*Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price $2. (To members, $1.60). 71 pages.*

Containing seven papers which were presented at the recent Symposium on Nondestructive Testing in the Missile Industry held in San Francisco, this volume has a two-fold purpose. These are to establish a background of unclassified literature on certain applications of nondestructive testing, and to stimulate thinking on the possibilities and potential of this method of inspection. Subjects covered are radiography of large solid propellant rocket motors; mobile field testing of missiles and aircraft; high-energy radiography; radiography of weldments in motion; ultrasonic detection, counting and fluid-contaminating particles; and ultrasonic standards.

THROW-AWAY CARBIDE INSERTS FOR CUTTING TOOLS—*Sponsored by Cemented Carbide Producers Association. Published by American Standards Association, Inc., 10 E. 40th St., New York 16, N. Y. Price $4.50. 50 pages.*

The nearly universal acceptance of insert tooling has led to the establishment of standards governing insert size and shape. In this book these standards are presented in tabular form with designations which refer to both the insert and the holder. Accompanying illustrations showing tool geometry simplify the task of correctly designating required inserts and holders.

WORLD SCREW THREAD STANDARDS—*Published by W. H. A. Robertson & Son, Ltd., Bedford, England. Price $1.50. 41 pages.*

This volume collates the screw-thread standards of 33 principal manufacturing countries of the world. The geometry of each type of thread is identified and illustrated, and the series in which it occurs is interpreted. Over 2000 standards are included and 108 thread forms are illustrated.

ENGINEERS VEST POCKET BOOK—*Published by Ottenheimer Publishers, Inc., 4805 Nelson Ave., Baltimore 15, Md. Price $.90. 192 pages.*

A true "vest pocket" book, this volume contains illustrations, tables, and charts, covering such topics as strength of gear teeth, thermal stress, chemical solubility, cost estimation and the resistance of an immersed body moving through fluid. Its 250 main items are marginally indexed under the headings: mathematics, building mechanics, heat, hydraulics, pipes, electricity, surveying, costing, mining, chemistry and miscellaneous data for easy reference.

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.....reader's viewpoints

. . . tolerances

Your article "Improving Reliability of Automatic Assembly Operations" in the May 1960 issue of THE TOOL ENGINEER came to my attention.

Your statements that ". . . when two mating components have dissimilar reliability curves. . . . Unacceptable fits occur even when both components are acceptable. . . ." has caused some concern.

From your example, it appears that your "fit" requirements which define an unacceptably loose or tight fit are tighter than those that would result from combining the tolerances of the screw and tapped hole in the typical arithmetic manner, i.e., screw tolerance plus tapped hole tolerance equals fit tolerance.

If your example has fit tolerances based on the statistical merger of tolerances of the screw and tapped hole, the specifications for the components tolerances become more critical. That is, the allowable shift in averages for lots must be specified, Sigma must be specified, and all lots must be near normal. Under these conditions, the chances are that unacceptable fits occur only when one or both of the components are not within tolerance.

It is our impression that industry actually enjoys better "fits" than specification tolerances normally provide by virtue of the statistical merger of tolerances which occurs even though we have not specified for it. Your paper indicates that the reverse is true, and we would appreciate receiving information concerning the cited example.

R. A. Bennett
The Martin Co.
Denver, Colo.

In the preparation of my original paper for publication in the May issue of THE TOOL ENGINEER, some of the written detail was omitted which, I am sure, would clarify this confusion. The paper treats *Fig.* 4 as follows:

"In machines which combine machining operations with assembly, further care is necessary in cases where the resulting fit is critical. For example in *Fig.* 4 if the tool capability curve is outside the component tolerance curve, loose assemblies may be expected between the lines Y+ and X– and tight assemblies between the line X+ and Y–."

"The condition created is that of two components having dissimilar reliability curves. A typical example exists in a

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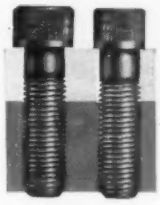

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machine where a tapping operation is performed at one station and a screw is inserted at another. If a Class 2 fit is required, the Class 1 fits produced between Y+ and X– and the Class 3 fits produced between X+ and Y– result in defective assemblies. Or, if the conditions are compatible at the start of operations, care must still be taken that the tools are not allowed to become dull . . . resulting in defects between X+ and Y–."

Arthur J. LaRue
International Business Machine Corp.
Burlington, Vermont

. . . numerical control

To the Editor:

Thank you for the copy of *Numerical Control Today*. This book is a timely addition to the literature on NC and it adequately covers the subject up to its present state of development.

It should be stressed that NC is still in its infancy and that we, as Americans, are tempted to "go overboard" in making a fad out of it. Two aspects of current engineering thinking are especially dangerous. One is the tendency to regard NC as a cure-all which will eliminate machining errors. Actually, it is a rapidly moving automaton which will do only what it is told to do. As such, it is entirely capable of reproducing human errors.

The second dangerous aspect of our thinking is the belief that by using NC we can minimize or eliminate setup tooling. This is wrong, since work still must be located, supported and held in correct relationship to the machine. Operational stresses are still present and may even be greater than those found in conventional machining. Means for reducing idle time also assume a greater importance because NC represents a larger investment. . . .

R. A. Smith
Pratt & Whitney Co., Inc.

. . . annual index

The December issue carried the Annual Editorial Index. Subjects from Ablation materials to Zirconium machining were covered in a single year of publication. This vast library of information belongs to each and every member of ASTME. It is our responsibility as engineers to use it—to put it to work for progress—to contribute to it when we can. In doing so we will be fulfilling our dedication as ASTME members. That is to insure the continued industrial leadership of America through knowledge, progress and productive capacity.

Joe Wrobel
Detroit Chapter No. 1

technical shorts

Operations Cryogenics—U. S. Steel has recently completed a series of tests on a new material expected to be used extensively for producing and storing liquified gases. Largest potential use is in the handling of liquified oxygen at —297 F. Other widely used gases which can be handled more efficiently in liquified form include ethylene, methane, argon and nitrogen. Called "Operations Cryogenics" the tests have shown that nine percent nickel steel can withstand stress and impact shock far in excess of that possible in materials currently used.

New High-Strength Steels—Two new high-strength, low-alloy steels, with minimum yield points of 50,000 and 45,000 psi respectively have been developed by Armco Steel Corporation. Designated as No. 6 and No. 7 the new grades are available as plates, hot-rolled sheets and hot-rolled strip.

Corrosion resistance of these steels is equivalent to mild, noncopper bearing steels. Their formability characteristics permit simple bending across the rolling direction, flanging and light forming operations of the type regularly performed on standard commercial quality sheet and plate.

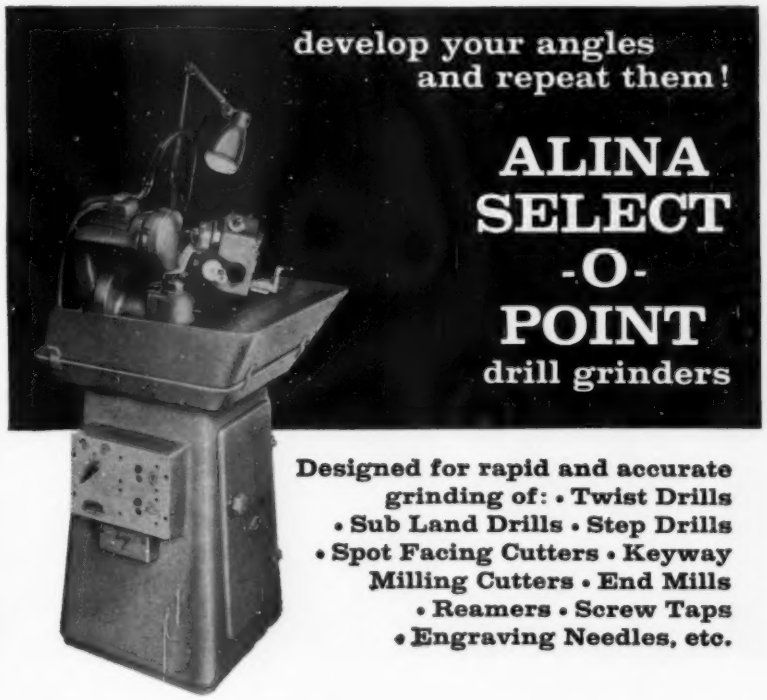
Armco High Strength No. 6 exhibits welding properties similar to a 0.20 percent carbon steel while No. 7 has properties similar to a 0.10 percent carbon steel. Hot-rolled products of both grades can be supplied in the pickled condition.

Precoated Aluminum—Frames and covers stamped from precoated aluminum have cut production costs by 60 percent and halved fabrication time for decimal counting units manufactured by the Berkely Div. of Beckman Instruments Inc., Richmond, Calif. Bridgeport Brass Co. supplies the aluminum coils, prepainted on both sides with baked gray enamel.

Key to sharply reduced production costs in this application is the number of operations eliminated in fabricating the frames and covers. When bare strip is used, parts go through the following steps: slit sheets to required width, stamp parts, transport parts to paint shop, wash and rack parts on painting screens, paint and cure frames and covers in gas ovens. When painted strip is used, the coils need only to be mounted on reels and stamped.

New Missile Alloy—A strong heat-resistant alloy, developed by Aluminum Company of America, will form a major structural part in super new defense missiles built by Boeing Airplane Co. Called "2219" the composition will be used by Boeing in an advanced version of Bomarc long-range defenders against enemy jets and airborne missiles. The alloy's application in a combination fuselage section and fuel tank will constitute its initial use in a major welded structure.

High-Speed Steel—The Crucible Steel Company of America has developed a new grade of high-speed steel designated Rex 49, designed to provide greatly increased tool life in machining hard-to-cut metals. Now undergoing evaluation in production use to confirm the preliminary laboratory and field tests, the new steel promises to be an outstanding composition for tools designed to cut such materials as highly alloyed steels at high-hardness levels, stainless steels and titanium.



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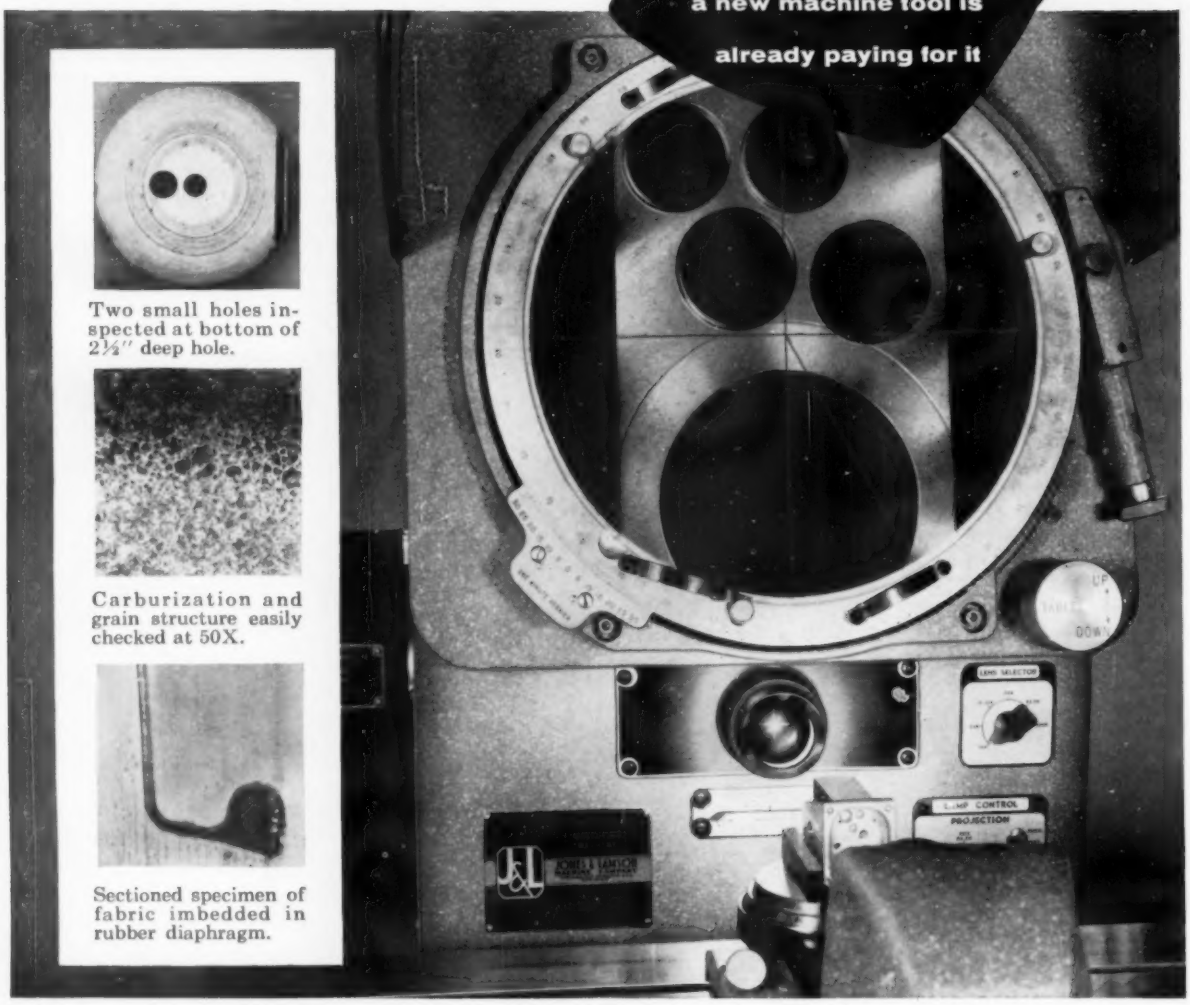

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Now, users of J & L FC-14 and TC-14 Optical Comparators can easily and accurately inspect cast materials, deep holes, and penetration of heat treat, and can make their over-all inspection operations more efficient than ever before.

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Trade Literature

CHARACTERISTICS, METALLURGY, markets and future trends of the American investment casting industry are included in a report given before the European Investment Casters Assn. WaiMet Alloys Co. **(Circle 501)** . . . Booklet entitled "Machining Kaiser Aluminum with Automatic Screw Machines" offers latest field data on this subject. Kaiser Aluminum & Chemical Corp. **(Circle 502)** . . . Machine control gages and automatic sorting gages are detailed in the first two sections of a catalog and a third section deals with gaging components. Federal Products Corp. **(Circle 503)** . . . A plant layout kit contains 187 items for obtaining a three-dimensional approach to all phases of plant design. Visual Plant Layouts, Inc. **(Circle 504)** . . . Drill presses, grinders, shapers, planers, jointers, metal and wood-cutting lathes, tilting arbor saws, band saws and radial saws are described in a 92-page catalog. Rockwell Mfg. Co. **(Circle 505)** . . . Latest *Powder Metallurgy Quarterly* presents case histories of a variety of small, complex powder metallurgy parts, illustrating the role of this process in miniaturization. It also describes sintered nickel cadmium batteries and their application in powering satellites. Metal Powder Industries Federation. **(Circle 506)**

Automation, Mechanization

A bulletin describes both point-to-point positioning and continuous-path control functions of a transistorized machine tool and summarizes computerless contouring; use of solid-state plug-in printed-circuit modules in high-speed logic circuitry; control power requirements; and physical dimensions. General Electric Co. **(Circle 507)** . . . A magnet-operated limit switch offers highly accurate position detection—without the use of arms, levers, rods, shafts or slots—of objects moving in erratic paths. General Electric Co. **(Circle 508)** . . . Bulletin entitled "Numerical Control Programming" describes the company's programming services and gives examples of finished parts. Rohr Aircraft Corp. **(Circle 509)** . . . A line of mechanical or cylinder actuated-in line transfer equipment includes units to move any part, vertically or horizontally, any distance through any manufacturing process. Livernois Engineering Co. **(Circle 510)** . . . Bulletin on Bazooka vacuum probe and transducer tells how production operators can pick up and handle miniature parts of all shapes and materials. Air-Vac Engineering Co. **(Circle 511)**

Boring, Drilling, Tapping

Catalog explains a boring bar tooling system including both general purpose and production bars for line and stub boring, and lists a line of bars and related tools and accessories. Giddings & Lewis Machine Tool Co. **(Circle 512)** . . . A tape-controlled 8-spindle turret drilling, tapping and boring machine has double housing planer type construction. Burg Tool Mfg. Co. **(Circle 513)** . . . The Bickford 11-inch radial drilling machine has adjustable hydraulic spindle counterbalancing, magnetic drive clutch, rigid head design and automatic tapping reverse. Giddings & Lewis Machine Tool Co. **(Circle 514)**

Casting, Molding

Pointers for producing sound zinc alloy die castings and the various factors that make this possible are contained in the latest edition of "Die Casting with Zinc Base Alloys." Henning Bros. **(Circle 515)** . . . Advantages and features of a new aluminum melting holding furnace for use in permanent mold, sand or die casting plants are given. Sunbeam Equipment Corp. **(Circle 516)**

Cleaning, Plating, Painting

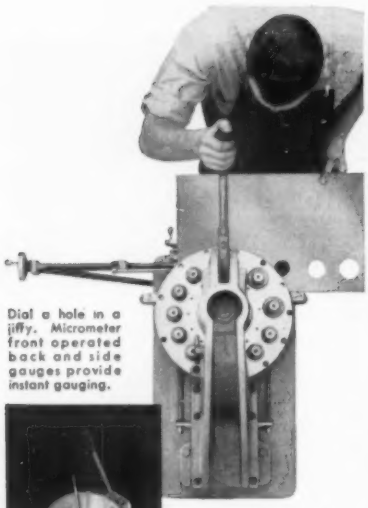
Three brochures cover an inhibitive primer for ending undercutting in severely contaminated industrial and marine applications; a modified coal tar emulsion coating for multipurpose protection; and a heavy-bodied emulsion material which combines coal tar protection with superior adhesive properties. Koppers Co. **(Circle 517)** . . . A control system using bell atomizers automatically paints parts of different sizes. Ransburg Electro-Coating Corp. **(Circle 518)** . . . The plasma spraying process has applications in the areas of high temperature protection; fabrication of parts and shapes of previously unworkable materials; and the depositing of carbide hard facing. Subjects covered in a brochure include materials sprayed, plasma sprayed coatings, materials which can be coated, surface preparation, nature of the coating bond and the plasma torch. Schori Process Corp. **(Circle 519)** . . . A pushbutton controlled table-room is designed to blast clean pieces of sizes ranging from small parts to castings or weldments up to 10 ft wide and weighing as much as six tons. Pangborn Corp. **(Circle 520)** . . . Booklet entitled "Ultrasonic Cleaning Primer" covering cleaning hints, applications, solvents and detergents and metal cleaning principles is accompanied by a catalog of equipment. National Ultrasonic Corp. **(Circle 521)**

Electric Motors, Controls, Drives

A 16-page static power conversion guide explains this field of controlled electrical power, outlines the advantages of its use and compares it with rotating electrical devices. Hamilton Standard Div., United Aircraft Corp. **(Circle 522)** . . . Bulletin describes panels for use with machine tools, pumps, materials handling equipment and presses. General Electric Co. **(Circle 523)** . . . Full line of gearmotors and coupled speed reducers is described and various applications given. Howell Electric Motors Co. **(Circle 524)** . . . Half-wave, fractional-horsepower, electronic adjustable speed drives use silicon controlled rectifiers instead of tubes to supply power to the motor. General Electric Co. **(Circle 525)**

Fastening, Joining

A catalog which describes various types, dimensions and fastening applications of solid groove pins and grooved drive studs includes a description of materials used, drilled hole tolerances, shear strength, maximum torque, insertion forces and horsepower transmitted. Groov-Pin Corp. **(Circle 526)**



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Trade Literature

Finishing, Grinding

Detailed brochure on special shape mounted point wheels gives complete specifications on wheels available, wheel shapes, wheel diameters, lengths and mandrel diameters. American Emery Wheel Works. **(Circle 527)** . . . Principal advantage of the 10-inch and 14-inch semiautomatic wheel grinders is the ability to simultaneously grind multiple line diameters in one operation. Landis Tool Co. **(Circle 528)**

Fluid Power

"Fluid Power News" presents four fluid power case histories including chill billet casting production in large aluminum plants; roll life on hold-down and lift systems on paper machines; speed synchronization between numerous sections of a paper machine; and steering gear dependability and characteristics on a cross section of vessel types. Oilgear Co. **(Circle 529)** . . . Specifications, features and response time of 25 fluid power valve types are covered, grouping the quick response, low-pressure drop models in straight-way, three-way and four-way types with various solenoid and air-operated heads, and by pipe sizes from 1/4 to 1 1/2 inches. Ross Operating Valve Co. **(Circle 530)**

Gearmaking

In addition to describing abrasive hard gear finishers and illustrating how they are used for final surface conditioning of gear teeth after hardening, this bulletin discusses various uses, how to produce crowns and tapers, cutting fluids, new resins for hones, automatic and manual hone dressing, and automatic loading and unloading. Michigan Tool Co. **(Circle 531)**

Heat-Treating

A bulletin describes a line of high-power induction heating generators, covering units from 15 to 50 kw, giving specifications and considerable detail on the engineering characteristics. McDowell Electronics, Inc. **(Circle 532)**

Indexing

A 12-page catalog presents technical specifications and illustrates typical applications for high-precision indexing tables for use on machine tools, inspection set-ups or combinations of the two. AA Gage Co. **(Circle 533)**

Inspection, Measurement

Thermochrom crayons and Detectotemp paints for checking the temperature of any hot surface are described. Eighteen crayons provide temperature measurements from 150 to 1240 F and 36 paints cover a measurement range from 104 to 2462 F. Curtiss-Wright Corp. **(Circle 534)**

Lathes

Brochure describing a complete line of machine tools includes five ram type and saddle type turret lathes, offering collet capacities from 1 to 5 inches, and 10 cutting-off lathes, offering collet capacities from 2 to 16 inches. Bardons & Oliver, Inc. **(Circle 535)** . . . Emphasis, in a booklet describing Swiss automatic bar machines and accessories, is given to a three-spindle universal attachment and a six-spindle hydraulic drum turret for performing end-operations such as centering, drilling, reaming, threading, tapping, milling, slotting and undercutting. American Bechler Corp. **(Circle 536)**

Materials

Characteristics and typical applications of Super Pyrotem, a highly alloyed die steel, are contained in a data sheet. Heppenstall Co. **(Circle 537)** . . . Weight and sizes of refractory materials can be computed with tungsten/molybdenum calculator. It has conversion tables for wire and rod and can be used as a slide calculator for rounds, squares, tubes, sheet ribbon and flat bar. General Electric Co. **(Circle 538)** . . . A bulletin describes a hard bronze die alloy for drawing, forming and bending stainless and clean mild steels. Ampco Metal, Inc. **(Circle 539)**

Pressworking

Over 360 drawings of standard and special press brake dies and tonnage requirement tables for both punching and bending various thicknesses of mild sheet steel are presented in a catalog. Valeron Corp. **(Circle 540)** . . . Product report describes inclinable, straight side and other presses which have sliding bolsters to cut die changeover time. Niagara Machine & Tool Works. **(Circle 541)** . . . Catalog covers 55-ton and 70-ton presses, available with air friction clutch and air-applied brake, and describes the automatic feed of the models. Havir Mfg. Co. **(Circle 542)** . . . A 4-page brochure describes the Autobend BC-100 press brake control. General Automation Corp. **(Circle 543)** . . . A bulletin which describes a blanking process that produces stamped low-carbon steel, stainless steel, aluminum, brass and copper blanks with straight, smooth edges in a single operation from coil or strip stock also covers tungsten carbide and tool steel dies for producing electric motor rotors and stators. Hydro-Cam Engineering Co. **(Circle 544)**

who's meeting and where

Feb. 1-3. INSTITUTE OF RADIO ENGINEERS. Winter convention on military electronics. Los Angeles, Calif.

Feb. 1-3. AMERICAN ROCKET SOCIETY. Solid propellant rocket conference. The Hotel Utah, Salt Lake City, Utah.

Feb. 2-3. ILLINOIS INSTITUTE OF TECHNOLOGY. Industrial management engineering conference. Illinois Institute of Technology, Chicago, Ill.

Feb. 3-4. INDUSTRIAL ENGINEERING INSTITUTE. Discussion topics will deal with factors in both human and machine production and future development of operations research. Schoenberg Hall, UCLA campus, Los Angeles, Calif.

Feb. 6-8. IOWA ENGINEERING SOCIETY. Annual meeting. Hotel Ft. Des Moines, Des Moines, Iowa.

Feb. 6-10. Norelco X-Ray School. Course will cover X-ray diffraction, diffractometry and spectrography. Henry Hudson Hotel, New York City, New York.

Feb. 7-9. Sixteenth Reinforced Plastics Div. conference. THE SOCIETY OF THE PLASTICS INDUSTRY, INC. Edgewater Beach Hotel, Chicago, Ill.

Feb. 9-10. AMERICAN FOUNDRYMEN'S SOCIETY. Wisconsin regional foundry conference. Hotel Schroeder, Milwaukee, Wis.

Feb. 9-11. NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS. Winter meeting. Hotel Ft. Des Moines, Des Moines, Iowa.

Feb. 13-15. PLUMBING BRASS INSTITUTE. Winter meeting. Riviera Hotel, Palm Springs, Calif.

Feb. 13-16. AMERICAN SOCIETY OF HEATING REFRIGERATING AND AIR CONDITIONING ENGINEERS. Semiannual meeting. Conrad Hilton Hotel, Chicago, Ill.

Feb. 15-17. AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AND INSTITUTE OF RADIO ENGINEERS. International solid state circuits conference. University of Pennsylvania and Sheraton Hotel, Philadelphia, Pa.

Feb. 16-17. AMERICAN SOCIETY FOR METALS. Symposium on recent developments in materials for nuclear applications. University of New Mexico. Albuquerque, N. M.

Feb. 19-23. AMERICAN INSTITUTE OF MINING, METALLURGICAL AND PETROLEUM ENGINEERS. Annual meeting. St. Louis, Mo.

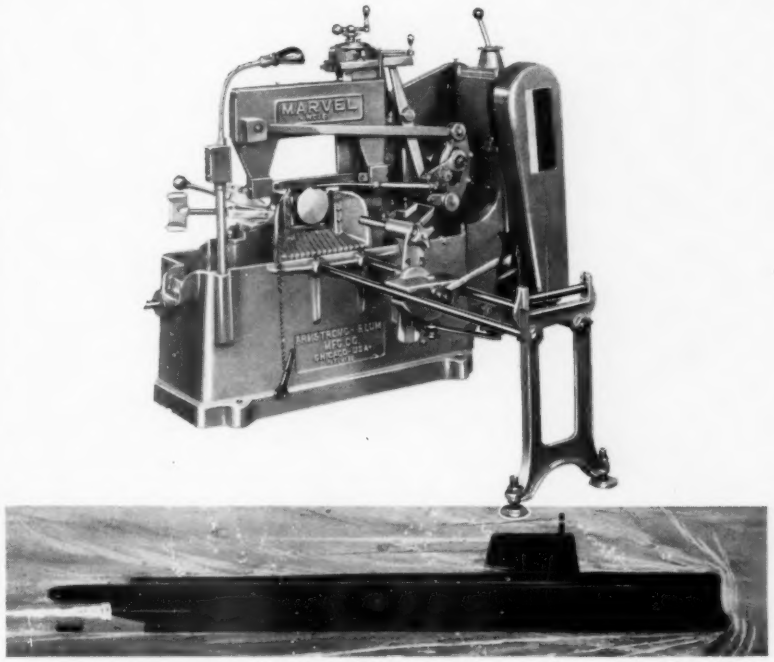
Feb. 20-23. Industrial Ventilation Conference. Sponsored by Michigan State University College of Engineering and Michigan Department of Health. Kellogg Center, E. Lansing, Mich.

Feb. 22-23. AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS. Seminar entitled "Automation and Numerical Control in Production." Bond Hotel, Hartford, Conn.

Feb. 24-25. COLORADO SOCIETY OF ENGINEERS. Annual convention. Denver Hilton Hotel, Denver, Colo.

Feb. 27-Mar. 1. ASSOCIATION OF IRON AND STEEL ENGINEERS meeting. Hotel Statler, Los Angeles, Calif.

Feb. 28-Mar. 2. Western Joint Computer Conference. Los Angeles, Calif.



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Obsolete? This Marvel Hack Saw Machine is as modern in performance as the next atomic powered submarine that will slide down the ways!

If you want faster cutting, the Marvel Hack Saw has speed to spare; accuracy of cut is assured by the rugged construction of the machine itself; blade cost, in many cases is less than 1¢ per cut.

When you consider these advantages and their low initial cost, Marvel No. 6 and No. 9 Series High Speed Heavy Duty Ball Bearing Hack Saws, as we build them, are your best cutting-off equipment buy today.

We can prove our point by demonstrating Marvel Sawing efficiency on your own work, without any obligation on your part. Because we have consistently built both Hack Saws and Band Saws for more than 40 years, we will give you an unbiased recommendation.

Catalog C-60 illustrates and describes the complete line of Marvel Sawing Machines. Write for your copy.

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3CS60

Field Notes

Seventy-six awards totaling $25,000 for the best papers explaining how the efficient application of arc welded steel has contributed or can contribute to progress in the design of a machine or structure are offered by the **James F. Lincoln Arc Welding Foundation.** Awards will be made in two separate noncompeting divisions—machines and structures. Any resident of the United States who has participated in the design, planning, manufacture or construction of the design described in the paper and who has been engaged as an officer, employee or consultant for the company or organization who produced or designed the machine or structure described is eligible. To qualify as a subject matter the design must have been either designed, redesigned or first fabricated within the period from July 1, 1959, to July 17, 1961. A copy of the rules may be obtained from the James F. Lincoln Arc Welding Foundation, P. O. Box 3035, Cleveland 17, Ohio.

Both the parts fabricator and the product manager of brass, nickel silver and prealloyed bronze powder is eligible to compete for the powder metal industry's annual award sponsored by the **New Jersey Zinc Co.** Originality of application, uniqueness of design, production economy achievements and the best utilization of metal powder properties and fabrication techniques are the criteria which judges will use in selecting the grand prize winner. One $500 award will be made to the individual chosen by the product manufacturer as the man most closely associated with the conception and design of the brass, nickel silver or prealloyed bronze part selected as the nonferrous metal powder part of the year. Another $500 award will go to the man deemed by the fabricator as most responsible for the successful production of the grand prize winner's part. Details are available from the Awards Editor, Metal Powder Press, New Jersey Zinc Co., 160 Front St., New York 38, N. Y.

acquisitions

The **Union Twist Drill Co.**, Athol, Mass., will acquire the entire business and assets of the **Reed Rolled Thread Die Co.**, Holden, Mass. Union plans to operate the business, which manufactures machines and tools in the field of chipless machining, as a wholly-owned subsidiary.

Under a recently announced agreement, **Rockwell Mfg. Co.**, Pittsburgh, will acquire the assets of the **Porter-Cable Machine Co.** Porter-Cable, manufacturers of portable electric power tools, will operate as a wholly-owned subsidiary of Rockwell.

The Bendix Corp., Detroit, has entered into a contract with the **Micrometrical Mfg. Co.**, Ann Arbor, Mich., to purchase its assets for cash. Micrometrical produces electronic-mechanical units for measuring the surface finish of metals, plastics and paper. The business will maintain its present name.

Dow Metal Products Co., a division of **Dow Chemical Co.**, recently announced plans to purchase the plant of the **Sheet Aluminum Corp.**, Jackson, Mich. Sheet Aluminum has been a wholly-owned subsidiary of **Mueller Brass Co.**, Port Huron, Mich.

Armco Steel Corp., Middletown, Ohio, has announced that two wholly-owned subsidiaries, the **National Supply Co.** and the **Union Wire Rope Corp.**, will be merged with Armco. National Supply, to be headed by Sidney A. Shuman, manufactures and distributes oil field machinery and equipment. Union Wire Rope, Kansas City, Mo., markets wire and wire rope. James H. Hatch will continue as manager of the Kansas City firm.

National Automatic Tool Co., Inc., has purchased the **Bucyrus-Erie Co.**, Richmond, Ind., plant. Natco, a builder of machine tools, will move from its present Richmond location, some six miles from the new plant. The Bucyrus-Erie plant, formerly used for the manufacture of well drilling equipment, will be used by Natco as the site of manufacturing plastics injection molding machines.

Dake Corp., Grand Haven, Mich., has purchased the Automold press line from the **Automold Co.**, a subsidiary of **Wagner Brothers, Inc.**, West Los Angeles, Calif. The Automold Co. manufactured automatic compression molding presses used in the plastics industry to form parts from thermosetting materials. The acquisition includes the use of the trade name and assets consisting of machinery and equipment, inventory, tools, dies, fixtures, patterns and manufacturing rights.

Purchase by **Parker-Hannifin Corp.**, Cleveland, of two Michigan concerns, the **Span Brass Mfg. Co.**, of Otsego, and the **Spanco Brass Sales Co.**, of Allegan, has been announced. In acquiring these companies, Parker-Hannifin obtains, according to board chairman C. C. Sigmier, "a line of low pressure brass fittings, noncompetitive with those presently manufactured by Parker-Hannifin which will reach new markets in the field of control, instrumentation and domestic appliances."

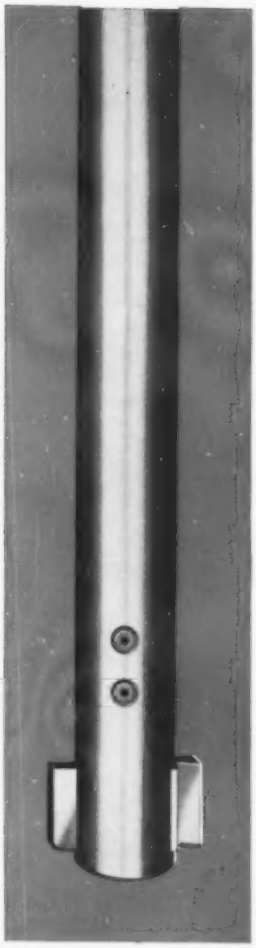
Magnaflux Corp., Chicago, a wholly-owned subsidiary of General Mills, has acquired **Metal Control Laboratories**, Los Angeles, to effect a complete complement of integrated nondestructive, metallurgical and physical testing facilities and skills. This acquisition will enable Magnaflux to meet the broader needs of the missile and aircraft, weld, forge and foundry, petroleum, automotive and general machining industries on the West Coast.

association news

The **American Powder Metallurgy Institute** has established a Western Pennsylvania section in the Latrobe-Johnstown-Ridgway-St. Marys area. Officers elected were as follows: Marshall E. Jetty, Brockway Pressed Metals, chairman; Gilbert J. Hoehn, International Powder Metallurgy Co., vice chairman; Calvin J. Bloom, Crane Co., treasurer; and John M. Eberhart, Brockway Pressed Metals, secretary.

The **Steel Founders' Society of America,** national association of the steel casting industry, in observance of its centennial in 1961, is adapting a new industry symbol. Lines lead from a molecular structure to form the dominant letters of the symbol—SC. The symbol, according to the Society, exemplifies the outstanding characteristics of steel casting: strength, shape and design versatility. The steel casting industry has an annual capacity of 2,500,000 net tons and employs more than 50,000 persons. Member foundries account for 90 percent of the commercial steel casting production in the United States.

Southern Methodist University has been awarded by the **National Science Foundation** a grant of $26,400 to conduct a study on the feasibility of making



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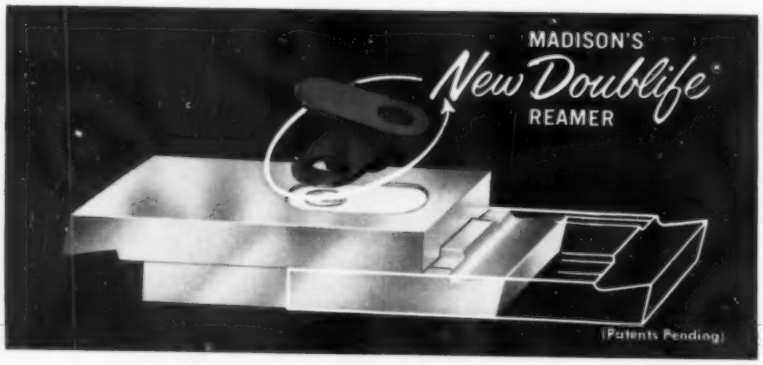

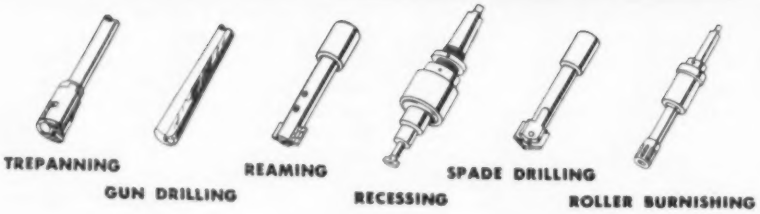

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Field Notes

the new science information center at SMU a regional scientific and technical information center serving the needs of southwestern industry and higher education. The building to house the center is a gift of local industrialists. Through personal interviews and questionnaires an attempt will be made to find out what kind of information research people need and in what subjects. Principal investigator for the study is William J. Graff, Jr., chairman of the SMU Department of Mechanical Engineering. He will be assisted by Sam G. Whitten, SMU science librarian.

awards

L. R. Miller, founding chairman of the Epoxy Resin Formulators Div., the **Society of the Plastics Industries, Inc.**, was recently presented with a scroll "for his guidance and counsel in the successful accomplishment of objectives" during the past three formative years of the association. Currently chairman of the test methods committee, Miller is president of Rezolin, Inc., Santa Monica, Calif.

expansions

Paul G. Langfeld, president of **Pfaff International Corp.**, announces that **G. M. Pfaff AG** has expanded its machine tool manufacturing branch in Kaiserslautern, Germany. The new operation includes new machine tools such as multistation transfer machines; multiple path drilling and milling machines; dial table machines; automatic turret lathes; universal feeders and loaders; tailstock driving units; and cross slide attachment units.

The **Dwyer-Baker Electronics Corp.**, Miami, Fla., has concluded arrangements for the construction of two plants in Israel manufacturing machine tools and aluminum products. The plants will be built and operated by the **Oritt-Israel Corp.**, a wholly owned subsidiary of Dwyer-Baker, at Kiriatgat. One of the factories will manufacture machine tools and dies; the other will produce various products in the aluminum field, including automatic vending machines.

Crucible Steel Co. of America, through its wholly owned subsidiary, **World Crucible, Ltd.**, has established an Australian company, **Crucible Steel Australia Pty., Ltd.** The company will distribute the full line of specialty steel products of **Crucible Steel of Canada, Ltd.**, and the United States company.

Punch Products Corp., Buffalo, has announced an agreement with **Wm. F. Beattie Associates,** Hamilton, Ontario, to manufacture and sell the entire line of Unipunch hole punching and notching equipment in Canada.

In order to participate in the growing industrial economy of India and the Far East, the **Bullard Co.,** Bridgeport, Conn., according to Francis L. Dabney, executive vice president, has licensed **Kirloskar Bros., Ltd.,** with home offices in South Satara, India, to build Bullard vertical turret lathes and horizontal boring machines. Kirloskar Bros., Ltd., has three large plants producing diesel engines, electric motors, pumps, valves and machine tools. S. L. Kirloskar, senior partner, is president of the Indian Machine Tool Assn.

Construction work on one of Chile's newest industrial operations, a plant for producing alloy grinding balls, is underway. **Armco Chile S. A.** is a corporation formed by the **Armco International Corp.,** Middletown, Ohio, and **Compania Electro Metalurgica S. A.** of Santiago, Chile. The joint venture will produce grinding media to be used chiefly by the Chilean copper mines.

Universal-Cyclops Steel Corp., Bridgeville, Pa., has expanded its specialty steel service center program to enable faster deliveries of stainless bar and wire and tool and die steels. Included is a greatly enlarged and modernized facility at Bridgeville and new and enlarged facilities at Titusville, Pa., Chicago, Cleveland, Detroit, New York and Worcester, Mass.

Wilson L. Fenn, president of **Fenn Mfg. Co.,** Newington, Conn., recently announced that a memorandum of agreement has been signed licensing **Komatsu Mfg. Co., Ltd.,** to build and market the Fenn line of rolling mills and related metal forming equipment in Japan and the adjacent Asiatic areas. Fenn also licensed **Marshall-Richards Machinery Co., Ltd.,** Durham, England, to manufacture its line for the European market.

moves

Simonds Canada Saw Co., Ltd., has moved its head office and plant to Granby, Quebec. Providing 112,000 sq ft of space all on one floor level, the plant is designed for straight line production of saws, machine knives and steel specialties.

Air Reduction Pacific Co.'s Portland, Ore., office has moved its sales, service and warehouse facilities into larger

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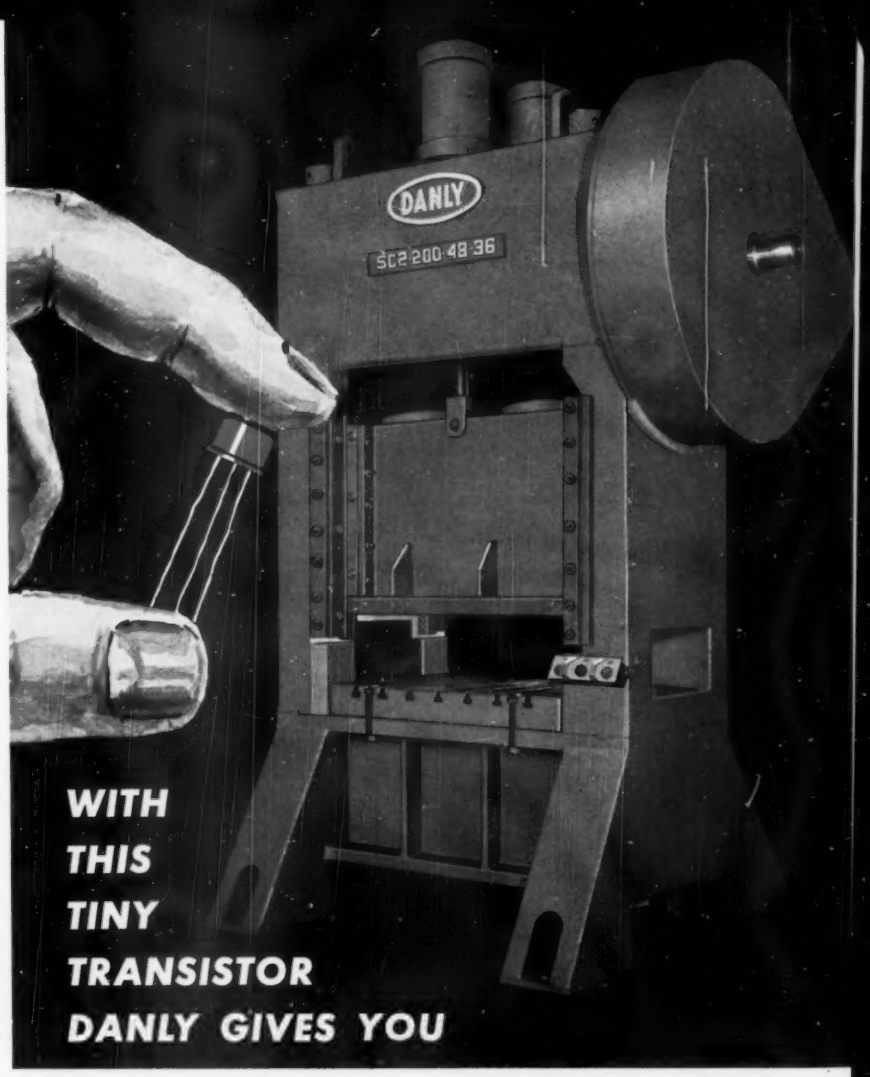

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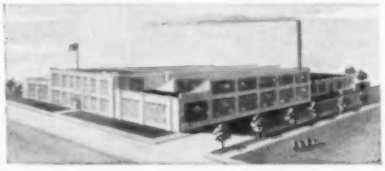

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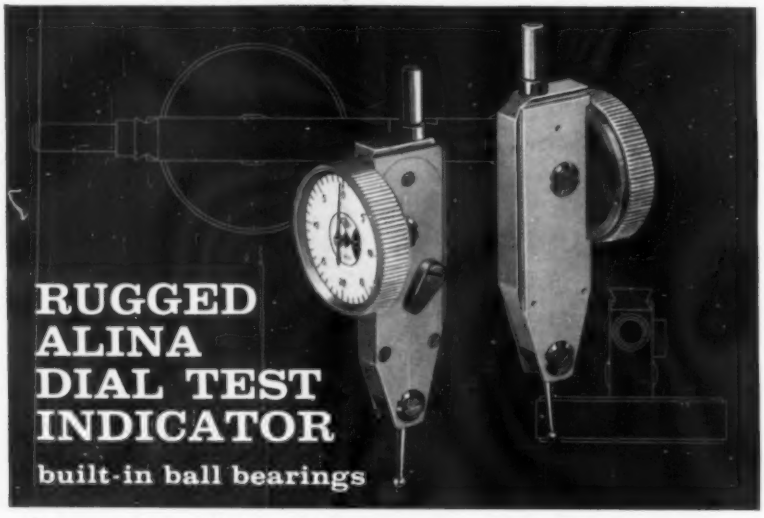

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Field Notes

quarters at 1325 N.W. Kearney St. A large area of the new facility has been set aside for the engineering service department where the company will work with its customers in special welding and cutting problems.

Unigage Corp., manufacturers of gaging equipment, has moved to 330 Interstate Rd., Addison, Ill. This announcement was made by Ronald Thacher, Unigage president.

Moving of the Chicago sales office to 6037 N. Cicero Ave. has been announced by the **American Nickeloid Co.**

Heller Tool Co. has relocated its Los Angeles branch office and warehouse at 1950 E. 20th St. The company produces files, hack saw and metal band saws, flat ground steel, hammers and carbide tools.

The **New Britain Machine Co.**, New Britain, Conn., has announced plans to relocate its Indiana-Kentucky-Ohio sales office from Cincinnati to 401 Leo St., P. O. Box 65, Dayton 4, Ohio. The new quarters in Dayton will be situated in the plant of a subsidiary, the **Koehler Aircraft Products Co.**

New address of the **Jowitt and Rodgers Co.**, manufacturers of surface grinding wheels, segments and disks for the metalworking field, will be 9400 State Rd., Philadelphia. The move doubles the firm's facilities.

Eastern offices and warehouses of the **Durkee-Atwood Co.**, Minneapolis, manufacturers of V-belts, automotive fan belts and other products are being moved from Newark into new and expanded quarters in Kearney, N. J.

name changes

The name of **Budd Co.'s** Canadian subsidiary has been changed from **Tatnall Measuring & Nuclear Systems, Ltd.**, to **Budd Instruments, Ltd.** Offices have been moved from Toronto to Don Mills, Ontario.

North American Aviation announced a change in the name of its missile division to Space and Information Systems Div. Harrison Storms is the newly-appointed vice president of the Downey, Calif., division.

American Standard Controls Div., is the new name of the **Detroit Controls Div., American Radiator & Standard Sanitary Corp.** The Company manu-

factures valves, controls and indicating instruments for gases, fluids and electrical energy.

Glenn Pacific Power Supply Corp., Oakland, Calif., has changed its name to **Glenn Pacific Corp.** The firm manufactures welding and industrial power supplies.

new activities

A contract for honeycomb components of the high-temperature range, 33-mpm, B-70 Valkyrie bomber was recently announced by **Ling-Temco Electronics, Inc.**, Dallas. Ling-Temco's subsidiary, **Temco Electronics & Missiles Co.**, is one of several firms under subcontract to **North American Aviation, Inc.**

Eutectic Welding Alloys Corp., Flushing, N. Y., has revealed plans to construct a $2,500,000 metallurgical plant and research center. Including a foundry capable of melting and pouring in any ferrous or nonferrous alloy, the center will be used for both the production of highly specialized alloys and for the development of new alloys systems, metallurgical processing procedures and materials standards and specifications. The new facilities also enable the firm to make rods and electrodes from virgin metal to finished products.

A newly organized corporate research and development staff will carry out basic and applied research projects for **Controls Co. of America.** The group will be headquartered in the few facilities in Wauwatosa, Wis. The staff will concentrate primarily on applied research activities pertaining to new product applications, materials and processes. Direction of the group will be under Roy W. Johnson.

Dearborn Tool and Die Co., Dearborn, Mich., has announced the formation of the **Dearborn Machine Tool Div.** The operation is equipped to handle boring problems from the floor to the part and is capable of producing boring equipment to meet customer specifications.

Establishment of a separate connector department within the **Electro Mechanical Instrument Div.** of **Consolidated Electrodynamics Corp.**, a subsidiary of **Bell & Howell Co.**, has been announced. Robert A. Hall has been named manager.

Under the terms of an agreement between **Jacobson Nut Mfg. Corp.**, Kenilworth, N. J., and **Australian Chemical Holdings, Ltd.**, Sydney, Australia, Jacobson will provide engineering know-how and equipment for manufacturing Jacobson products by Australian Chemical for the Australian market. Jacobson manufactures industrial fasteners.

new facilities

Construction will soon begin on a 31,500-sq ft addition to the instrument division plant at Watertown, Wis., according to the **Durant Mfg. Co.** Upon completion, Durant plans a step-by-step transfer of all manufacturing, production control, engineering and related activities from Milwaukee to Watertown. The company manufactures counting and measuring instruments.

Simonds Abrasive Co., Philadelphia, has announced the opening of a new Southern California branch warehouse, sales office and service shop in Los Angeles. The branch will also serve as headquarters for **Heller Tool Co.** and **Simonds Saw and Steel Co.**, divisions of the Simonds Co.

Answers

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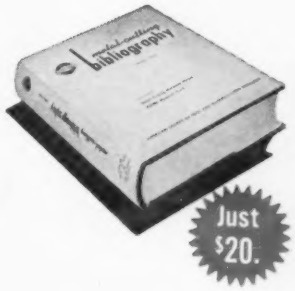

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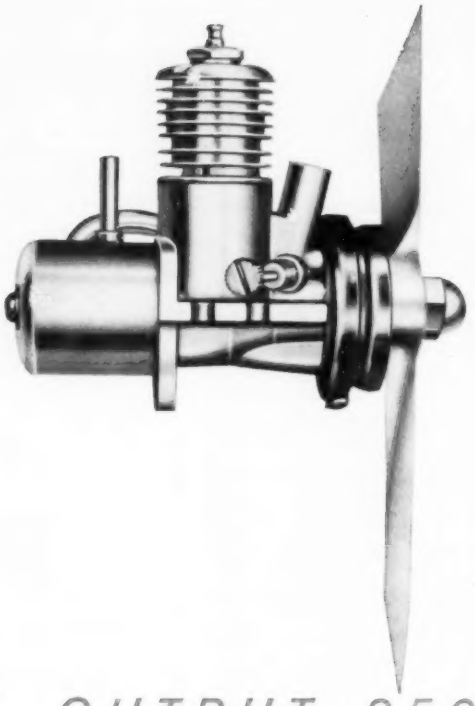

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TOOL ENGINEERING in Europe

By M. Kronenberg
Consulting Engineer
Cincinnati 6, Ohio

Metalcutting with Liquids

During the lively discussions that followed the presentation of papers on ultrahigh-speed machining at an ASTME Seminar several years ago, someone remarked that ". . . we will never be able to cut steel with butter."

Recent developments make it appear that cutting steel with butter—or at least with fluids under high pressure—is a definite possibility.

A short note in *Metal Industry* (London), Vol. 96 (16), 1960, p. 306, says that Russian engineers have developed a method of cutting metals with a high-speed jet of liquid. The jet, which is about 0.040 inch in diameter, reaches velocities up to 120,000 fpm.

With this jet, Russian engineers have been able to perforate an 0.060-inch-thick aluminum specimen in five seconds. The specimen was placed about two inches from the nozzle. These engineers also succeeded in penetrating an alloy steel specimen under the same conditions. "Machining" time in this instance was 180 seconds.

The rate of perforation (metal-removal) increases with increasing jet velocity but is reduced as the distance of the specimen from the nozzle is increased. This effect is presumably due to the jet becoming discontinuous as the distance from the nozzle increases.

The angle formed between the jet and the surface of the specimen also has an effect on the rate of perforation. When the specimen surface is near to the nozzle, maximum perforation is obtained with a 45-deg angle. When the surface is some distance from the nozzle, maximum perforation is obtained with a 90-deg. angle.

Metal-removal rates are highest during the first few seconds of cutting. This may perhaps be explained by the fact that a water cushion is formed after a cavity has been developed, thus slowing down the metal-removal rate.

While this is an interesting development, it should be pointed out that the maximum metal-removal rate attained is less than one cubic inch per minute. With American methods of ultrahigh-speed machining, in which explosives are used to propel cutting tools at a speed of 120,000 fpm (the same speed as the jet in the Russian experiments), the metal-removal rate exceeds 3000 cubic inches per minute.

Machine Tool Expositions

Last September there were three major machine tool expositions: one in the United States (Chicago), one in West Germany (Hannover) and one behind the Iron curtain (Bruenn, Czechoslovakia). A report on the Hannover exposition by K. Schroedfer appears in *Werkstatt und Betrieb*, Vol. 93 (90), 1960, p. 529-595. The title of the article is "Werkzeugmaschinen Ausstellung Hannover 1960." A report on the Bruenn exposition appears in the Swiss magazine *Technica*, No. 24, 1960. This article, by "C.V.E.", is entitled "Spanabhebende tschechische Werkzeugmaschinen auf der 2ten internationalen Messe Bruenn."

Some seventy machine tools were exhibited at the Bruenn exposition. "C.V.E." says that about 21 of these represent new developments. The machines exhibited were designed for increased automation, particularly small-lot automation. Some examples are turret lathes with preselectable feeds and speeds, and lathes equipped with copying devices.

Only a few of the machine tools shown were equipped with numerical controls, in contrast to the more than 100 machines so equipped at the Chicago exposition. One of the milling machines exhibited is tape controlled, but for rectangular motions only. The table of one jig borer is controlled by punched tape. Induction nuts and leadscrews are used with this machine to measure table positions accurately.

Several improved lathes, some with automated thread cutting attachments and reversible leadscrews, were exhibited at Hannover. Hardened and chromium-plated steel bedways have become more common. Some machine elements are now joined with adhesives, a method adopted from the aircraft industry. Single-spindle screw machines have been improved.

Milling machines have also been improved. Several of the milling machines shown at the Hannover exposition are of rigid construction and have high cutting capacity and a streamlined appearance. A French milling machine shown at the exposition is capable of accommodating 10-ton workpieces. It has an electronic copying device that couples two basic milling machines. The tracing of a prototype takes place on one machine and cutting is performed on the second machine. The two machines can be at some distance from each other.

Another milling machine exhibited at Hannover is designed for the machining of welded seams, worn-out rails and similar work. It can be run at feeds from 40 to 160 inches per minute, using carbide inserts.

In view of the increasing use of flammable work materials, one of the devices exhibited at Hannover is of special interest. The device consists of an elliptical reflector that is used to focus heat (from a heating element) on a sample of the work material. A stopwatch is used to measure the time required for the material to burst into flame. Attachments such as optical recorders, sparking devices and so on are available for use when great accuracy is required.

Machine Table Accuracy

The positional accuracy of the tables used on numerically controlled machines depends to a considerable extent on the masses that must be decelerated shortly before the required table position is reached. C. Stromberger and H. Politsch have developed a device for measuring accuracy of table positioning under various conditions and report on their findings in *Werkstatt und Betrieb*, Vol. 93, No. 9, 1960, p. 597-603. The title of their article is: "Erfahrungen mit einer einfachen digitalen Wegmesseinrichtung."

Table overtravel was measured by the authors under three conditions: (1) when the feed drive was coasting with the table; (2) when a brake was applied; and (3) when the table was coasting freely to a stop. The feed rate was variable in nine steps between 4.3 ipm and 54 ipm. Coasting velocity was adjustable between 0.16 ipm and 2.4 ipm by changing the rotor voltage of the d-c motor driving the table.

It was found that the load transmitted by the leadscrew had an effect on positioning accuracy. In the case of a leadscrew under load and a coasting velocity of 1.6 ipm, overtravel was about 0.0036 inch when the feed drive was coasting with the table, about 0.002 inch when the brake was applied and about 0.001 inch when the table was coasting freely with the motor drive disconnected.

When the leadscrew was preloaded by a spring, overtravel was reduced when the feed drive was coasting with the table and also when a brake was applied, but was increased when the table was coasting freely to a stop, as might be expected.

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spindle temperature, all affect positioning accuracy. Spindle temperatures are dependent on the time of engagement of screw and nut, which is in turn dependent on the feed rate.

The authors conclude that it is possible to obtain good positioning accuracies when ball spindles are used and that it is advisable to disconnect the driving masses from the table shortly before positioning is to be completed.

Punching Hard Steel

Built-up edges similar to those found on milling cutters are also observed on punches. These built-up edges can adversely affect tool life, clearances and other qualities, particularly when punching heavy, hard steel blanks. In an article in *Werkstattstechnik*, Vol. 50 (11), 1960, G. Oehler reports on investigations undertaken to improve punch life. His article is entitled: "Schwierigkeiten beim Lochen dicker and harter Stahlbleche."

Oehler points out that while small clearances are usually recommended for the punching of light, soft sheet metals, small clearances often have an adverse effect on the surface finishes of punched holes. In the case of hard, heavy materials, cracks may develop if clearances are small. These cracks may be caused by built-up edges on the punch, which would have the effect of decreasing clearances further.

The author reports on a meeting in Sweden, where several papers were presented on clearances and other subjects related to sheet-metal punching and forming. It was apparent at this meeting that there is a considerable difference of opinion as to the most desirable punch clearances for both soft and hard metals. The clearances recommended by different authorities may vary by as much as 200 percent.

In his article, Oehler gives two equations (using metric dimensions) relating clearance to the thickness and tensile strength of sheet metal, and to a numerical constant.

Shearing Forces

In an article in the magazine *T.Z. fuer praktische Metallbearbeitung*, Vol. 54 (8), 1960, p. 366-369, E. Plum gives equations for the cutting forces involved in shearing. The title of his article is: "Blechtafelscheren fuer die wirtschaftliche Fertigung."

Material thickness and tensile strength, and the rake angle between the machine ram and bed are taken into account in the equations. Cutting force increases in a manner inversely proportional to the tangent of the rake angle, indicating an increase in cutting force with decreasing rake angle. For this

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reason shearing is somewhat easier with large rake angles but, of course, the load on the machine is heavier. Material thickness enters the force formula in the second power. Thus cutting force increases four times when the material thickness is doubled.

The author also discusses the cutting force component in the direction parallel to the bed surface. In order to avoid or minimize distortion in cut-off pieces, he recommends adapting the rake angle to the material thickness. Data given with the article shows how this is done.

Lubrication of NC Machines

The accurate positioning of tables, carriages and other elements of machine tools that are supported by the guide ways depends to a considerable extent on the "stick-slip" effect caused by changes in the coefficient of friction as the table is coasting to position.

Ways to overcome stick-slip phenomena have been investigated in many countries. The development of lubricants that prevent the coefficient of friction from building up is one possible solution.

Recent Russian work along this line is described by B. B. Lure and R. N. Osher in an article in *Stanki i Instrument*, translated into English in *Machines and Tooling*, Vol. 31 (7), 1960, p. 18-22 under the title: "Oils Which Ensure Uniformity of Machine Tool Table Feeds."

Research carried out in England, in West Germany and in Czechoslovakia is described, as is work done at the Moscow Research Institute for Machine Tools (Enims). At the Moscow Institute, various salts of aliphatic (fatty) acids were tried out as an additive. These acids are highly adsorbable on metallic surfaces and minimize the effects of changes in friction.

The authors tested six different oils and came to the conclusion that an oil identified as Industrial Oil No. 12 was best, with additives of oleic acid, chlorinated stearin, aluminum stearate and a grease described as AMS 3, which contains aluminum oleostearate.

The effectiveness of Oil No. 12 is attributable to its aluminum stearate content, according to the authors. Aluminum stearate causes a soap film to form on the metal surfaces. The high viscosity of soap helps to form lubricant films that separate the surfaces when sliding speeds are such that hydrodynamic lubrication is impossible.

During testing, stick-slip conditions were measured on a special test stand, using Wheatstone bridges to determine the relationship between friction vibration and sliding speeds, drive rigidity, and coefficients of friction.

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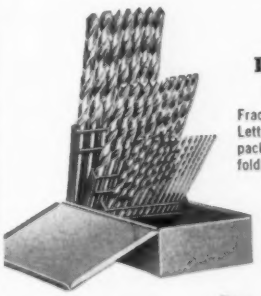

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Metal Bonded Graphite

Tech Digests

New metal bonded graphite materials, containing up to 90 volume percent graphite, and exhibiting improved mechanical properties have been developed. The process used for the fabrication of these materials utilizes conventional powder metallurgy cold-forming techniques and liquid phase sintering, which heretofore has not been possible because of the poor compatibility of liquid metals with graphite.

Liquid phase sintering of preformed powder compacts is employed in such well-known polyphase systems as iron-

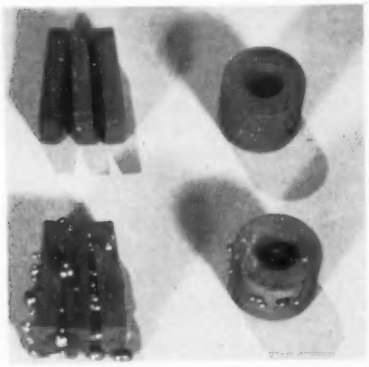

Fig. 1. (top) New metal bonded graphite materials do not sweat. (bottom) Sweating indicates incompatibility of graphite and liquid metals.

coper, coper-nickel-tungsten, and the cemented carbides. It offers the advantages of high-sintering rates, and a rapid approach to equilibrium structures. In these compositions liquid phase sintering is no particular problem. With oxide base cermets, however, it is not unusual to observe a "sweating" of the liquid metal from the compact during the course of sintering. Unfortunately, this "sweating" tendency is also a common occurrence in metal-graphite systems, as shown in *Fig.* 1.

The macroscopic phenomenon of "sweating" is attributed to the poor wettability of the solid by the liquid, which in turn is a manifestation of the quantitative relationship between the various interface energies acting on the system, as shown in *Fig.* 2. At equilibrium, the drop assumes a shape that is determined by gravitational and surface forces acting upon it. The degree of wetting is usually denoted by the contact angle, θ, which is the included angle measured through the liquid phase, and is determined by the mag-

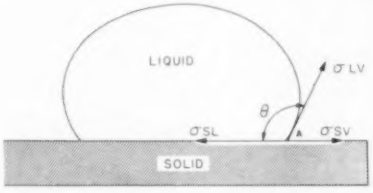

Fig. 2. Quantitive relationship of various interface energies acting on the sweating phenomenon.

nitude of the various surface energies acting at the point of contact, *A*, between the liquid-solid-gas phases.

When the contact angle is greater than 90 deg, the solid-liquid interface energy is greater than the solid-vapor interface energy. In the course of sintering systems that show this behavior, a sweating of the liquid phase would occur since this would result in a decrease in the high-energy solid-liquid interface area, and consequently a decrease in the total surface free energy. Conversely, the liquid would be retained within the compact when the contact angle is less than 90 deg. It, therefore, is possible from wettability studies to predict the macroscopic sintering behavior of liquid-solid systems.

From precise measurements of the contact angle and liquid-gas surface tension, it is possible to study quantitatively the changes in the solid-liquid interface energy resulting from composition change in the liquid. In this investigation the sessile drop technique had been employed for the contact angle and liquid surface tension measurements. Briefly, this method comprises forming a liquid drop on a solid substrate, photographing the drop profile at elevated temperatures, and calculating the liquid surface tension and contact angle from measurements of various shape parameters.

As a result of the apparent anomalous sintering behavior of the iron group metals, a more detailed investigation of wetting in the iron-graphite system was conducted to examine the influence of alloying additions of carbon to iron. A series of iron-carbon alloys was prepared containing various amounts of carbon. Alloy specimens were placed on graphite substrates and rapidly heated to the liquidus temperature in order to minimize carbon diffusion from the substrate into the alloy. The contact angle reported is that observed immediately upon melting of the alloy. The results of this study, shown in *Fig.* 3, indicate that the wetting action of iron on graphite is a function of the carbon content in the iron, and an abrupt change from wetting to nonwetting takes place at about the eutectic composition (4.3 weight percent carbon).

Surface tension measurements were also made on the various iron-carbon alloys. It was found that carbon did not

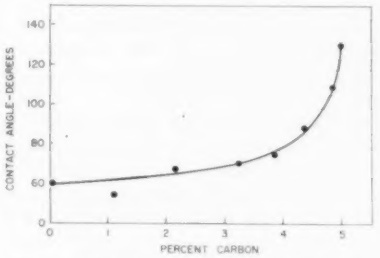

Fig. 3. Wetting action of iron is affected by its carbon content.

influence the surface tension of iron (about 1970 dynes/cm). Assuming the graphite-gas interface energy to be constant, then the liquid iron alloy-graphite interface energy is also a function of the carbon content in the iron, and increases abruptly at about the eutectic composition.

Considering the nonwetting of a graphite by carbon saturated iron, sweating of the metal phase during

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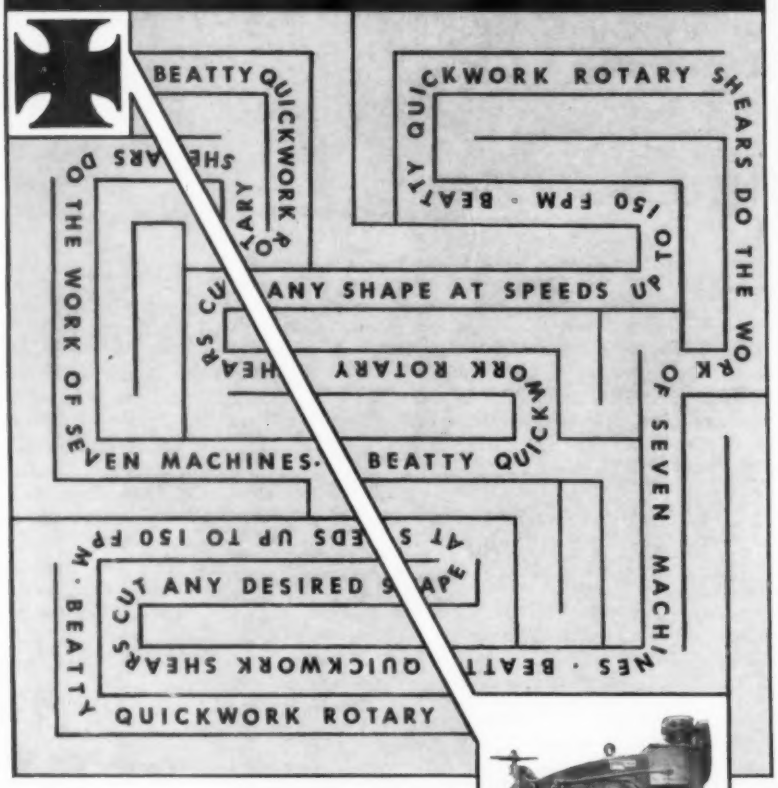
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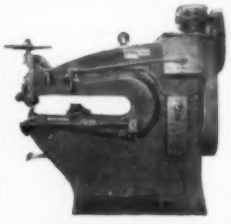

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liquid phase sintering of iron-graphite compacts would be anticipated. Nonwetting contact angles of 145 deg and 130 deg were also measured for carbon saturated nickel and cobalt alloys respectively on graphite, thereby, accounting for the sweating observed with these metals during the sintering.

Thus, it is necessary to improve the wettability of graphite in order to successfully liquid phase sinter metal-graphite compacts containing iron, nickel, cobalt, copper, silver or aluminum. Wetting could be enhanced only by decreasing the solid-liquid interface energy. One approach is to introduce surface active alloying additions.

The strength of the iron-graphite composition was determined both in cross bending and compression. An optimum strength is obtained at approximately 5 percent calcium-silicon. For the graphite-rich compositions, the strengths are equal to and superior to the best obtained on pure graphite materials, while for the metal-rich compositions, the strengths compare favorably with the best obtained in the porous metal compositions used for bearing applications. Although no precise elongation measurements have been made, compositions containing in excess of 40 volume percent iron showed permanent deformation during bend tests, and all compositions, including the 10 Fe - 90 Graphite could be subjected to secondary coining operations.

The compressive strengths for compositions of variable iron content was studied for both as-sintered ferritic and heat treated martensitic structures. Heat treatment consisted of austenitizing at 1850 F, oil quenching, and tempering at 400 F.

Although the strength of the metal phase is increased substantially by heat treatment, this has little effect on the strength of the composite material for compositions below 30 volume percent iron. A possible explanation may involve a change in the metal phase continuity at this level, and consequently, a change in fracture path. An indication of a change in metal phase continuity with increasing metal content is obtained from resistivity measurements that show an abrupt change in slope at about 30 percent metal level.

With the broad range of compositions available, these materials are being considered for both dry and externally lubricated bearing environments. *Fig.* 4 shows results of preliminary studies on the wear of graphite-rich iron compositions and commercial graphite bearing materials riding dry on a steel jour-

nal. The wear of the graphite-rich compositions is in the same range as the graphite materials. Advantages offered by the metal-graphite compositions are improved mechanical properties, the use of high-volume powder metallurgy

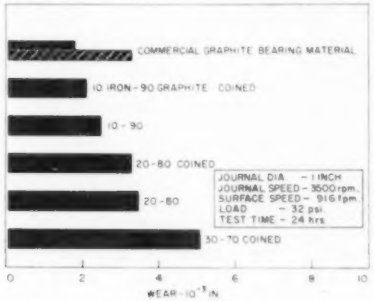

Fig. 4. Dry wear test results.

production techniques, and close dimensional control of parts by meaus of secondary sizing operations.

Another type of application involves the use of oil impregnated, porous metal bearing. Oil impregnation studies on the metal-graphite compositions showed that the porosity in these materials is continuous. The results of comparative wear rates of oil impregnated porous bronze and 40 iron - 60 graphite materials were evaluated.

Results shown in *Fig.* 5 indicate a lower wear rate for the iron-graphite

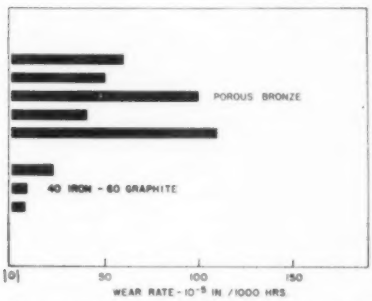

Fig. 5. Lubricated bearing test results.

compositions. More comprehensive data are being obtained on the performance of the oil impregnated iron-graphites at various loads and speeds in order to establish the PV factor (load x velocity) for these materials. For the porous bronze materials, the PV value is reported to be about 50,000. Preliminary results on iron-graphite indicate that PV values approaching 200,000 may possibly be attained.

From "Metal Bonded Graphite," by M. Humenik, D. W. Hall and R. L. Van Alsten. Presented at the 42nd National Metal Congress, American Institute of Metallurgy, Mining and Petroleum Engineers, 29 W. 39th St., New York 18, N. Y.

Reliability Implementation In Engineering Design

As the result of a twelve-year study of several hundred of the most common causes of mechanical failure of metals, a summary report was prepared by the Metallurgy Div. of the National Bureau of Standards. This report established fatigue as the most common cause of mechanical failure of metals. The primary factor was the geometry of the part—not the material. A large percentage of failures could have been eliminated by improved design.

A similar condition is also reflected in electronic design where 55 percent of all failures of airborne equipment were attributed to misapplication. However, it was additionally determined that these shortcomings were only resultant in 5 percent of the applications.

This follows general statistical evidence that a small percentage of offenders cause most of the catastrophic problems.

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been applied to the study and control of equipment reliability.

The AFBM reliability definition is: "the probability that an item will operate within specified limits for the time and operating conditions specified, utilizing supporting equipment and procedures in the manner intended."

The design parameters involving measurement and fulfillment of required performance during specified periods of operation and the interpretation of such data for prediction purposes are very important. These factors constitute the engineering technology of reliability. This paper illustrates the techniques of data development through statistical reduction methods. It follows with analysis of failure trends and the formulation of derating stress factors. Also considered is the application of reliability relationships through engineering techniques and assurance of reliable design through design review.

Based on a paper by I. Doshay, Aerojet-General Corp. Presented at the SAE National Aeronautic Meeting. Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

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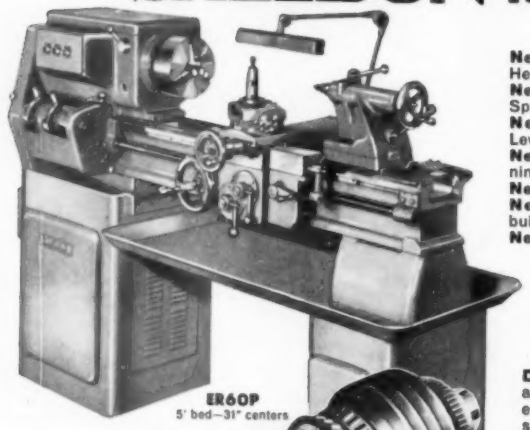

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Analog Welding Control

A new method and control has been developed for automatic gas tungsten-arc welding stainless-steel sheets of uniformly tapered thickness. The basic concept in this new method is that the four major welding parameters—voltage, current, wire-feed speed, and carriage speed—are functions dependent on the material thickness and, therefore, in tapered sheet welding are also functions of the carriage position. Accordingly, in this new control, these welding parameters are made to vary as functions of the carriage position. Means are provided for independent control of the parameters, thus permitting the limits within which each parameter varies to be independently established.

To set the control for any welding application, the procedure is as follows: first, the starting and ending positions of the workpiece are "dialed in" on the control; then, the values of the four welding parameters for the material thickness at the starting position, and those for the thickness at the ending position, are "dialed in" on the control. The values of the welding parameters at intermediate carriage positions are linear interpolations between the starting and ending values, changing continuously as the carriage moves from the starting position to the ending position of the workpiece.

Setting up the control is direct and simple; and does not require any programming equipment or control cams. Changing settings to accommodate different workpiece conditions is a straightforward procedure requiring only a few minutes.

Control Features: To accomplish its final purpose, the machine, comprised essentially two blocks: one block could be described as being a simple analog computer. The other block comprised the four servomechanisms which actually enforce the four welding parameters, according to the analog signal given by the computer.

The operations carried out by the computer were linear interpolations simply obtained by means of a set of four potentiometers, one for each parameter. The potential at the beginning and at the end of each potentiometer winding represented the initial and final value of the parameter involved.

The voltages produced by these computing potentiometers were applied to each of the servomechanisms controlling the four welding parameters. To work satisfactorily, those servomechanisms must accurately adjust the welding parameter on which they have action to a value exactly proportional to the analog voltage produced by the computer. The proportionality between the value of the

parameter and the value of the corresponding voltage manufactured by the computer must remain numerically constant throughout the life of the machine. This characteristic corresponds to the concept of the zero-error servomechanism which has been built into the design of the tapered sheet-welding machine.

Tooling Features: The 16-ft clamping fixture and side beam carriage were designed for maximum rigidity and minimum deflection under clamping forces. The clamping system was hydraulically operated with a dual-pressure feature. The low pressure was provided by a high-volume hydraulic pump, which also could be regulated to provide a controlled clamping force. Uniformity of clamping was insured by the large number of individual cylinders, each applying the clamping force to a continuous copper clamping finger.

The finger spacing was adjusted at each end of the machine by means of a crank wheel and was indicated on a counter reading directly in thousandths of an inch. Thus, it was possible to set the finger spacing at different values at each end and obtain a uniformly tapered spacing throughout the length of the machine.

The backing mandrel consisted of two flat copper bars. The space between them formed the backing groove, which also could be tapered to suit welding requirements. The mandrels could be preheated and were thermostatically controlled. The backing gas was manifolded to various plenum chambers and was introduced through small orifices into the space between the two backing bars, i.e., the backing groove.

Welding Parameters: Stainless-steel sheets tapering from 0.010 to 0.100 inch in lengths of 4, 6, 8 and 16 ft were welded. The material was AM-350.

It was necessary to establish settings for the end conditions which, when interpolated, would give good results in the intermediate range. Obviously, an arbitrary choice for the end values did not necessarily fit the intermediate conditions, particularly if there was a considerable difference between the end conditions. The question arose as to whether it was possible to find such a set of end conditions when the interpolation is linear.

This question was resolved when the correct parameters were found and uniform penetration and buildup were obtained throughout the length of a 6-foot piece tapering from 0.010 to 0.100 inch. The key to the problem was to have a ratio of finger spacing to groove width which decreased with increasing thickness. The finger spacing was 0.100 inch and the groove width was 0.050 inch for the 0.010 inch thickness while the finger spacing was 0.375 inch and the groove width was 0.250 inch for the 0.100 inch thickness.

It was found that the settings used on the 6-foot taper were satisfactory for all the other lengths, i.e., 4, 8, 16 feet, and, that the only changes that had to be made on the machine settings were the starting and ending position. The tooling was easily changed to accommodate the various taper lengths.

In conclusion, this method was found to be a practical, versatile and highly reliable means of producing welds in tapered sheets.

Based on a paper "A New Method of Fusion Welding Tapered Sheets" by A. Sciaky and M. Sommeria, Sciaky Brothers, Inc. Presented at the AWS National Fall Meeting 1960, sponsored by American Welding Society, 33 W. 39th St., New York 18, N. Y.

Inorganic Adhesive Bonding

For service temperatures from liquid oxygen temperatures to approximately 2000 F, conventional metallic braze and glassy ceramic bonding processes are applicable and the processes and materials are covered in the literature.

For the temperature range from 2000 to 3000 F, the nickel and cobalt base alloys and the precious metal metallic brazes, including molten refractory borides, are applicable while the glassy ceramic bonding materials and processes need continued research and development.

In the temperature range from 3000 to 5000 F, molten refractory carbides and borides, molten high-melting point metals and metallic diffusion bonding processes seem applicable but require considerable basic research and development. The use of ceramic adhesives in this temperature range would depend on the development of high-melting point glasses, divitrified high-melting point glasses, and on high-melting ceramic solid solution or eutectic molten phases. Twenty-one references are listed in the bibliography of this paper.

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Based on a paper by Roger A. Long, Manager, Narmco Industries Inc. Presented at the SAE National Aeronautic Meeting. Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

GRAYMILLS *Superflo* COOLANT PUMPS

Thousands of GRAYMILLS Centrifugal Superflo Pumps have been installed as original equipment; and thousands more are in use as conversion or replacement units. In addition to continuous use for pumping coolants, they've been used to pump abrasive slurries, ground glass, lens polishing rouge, enamels, lacquers and degreasing solvents. Over millions of hours of operation, the name GRAYMILLS has become synonymous with pumping performance. Available in 36 standard models completely interchangeable with other makes. Don't replace trouble with trouble . . . put a GRAYMILLS Coolant Pump on your machine and *relax!* They're sold by leading industrial distributors everywhere. Write for complete catalog—No. 56R

GRAY-MILLS

GRAYMILLS CORPORATION

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DESIGNED AND PRICED FOR MACHINE BUILDERS USE

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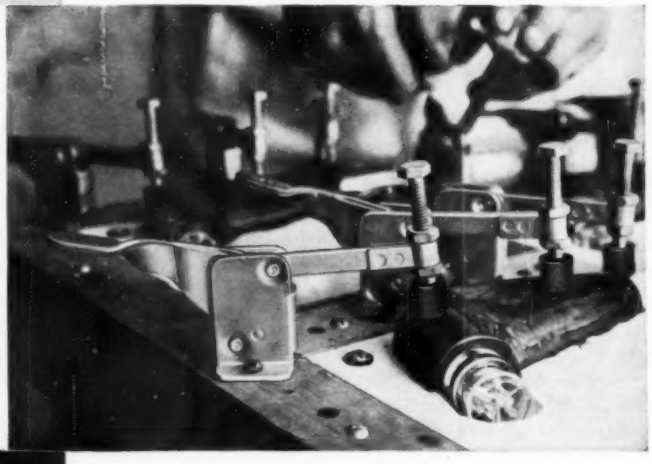
Look what clamps are doing!

Practical uses of Wespo Toggle Clamps and Pliers that may suggest ways you can save

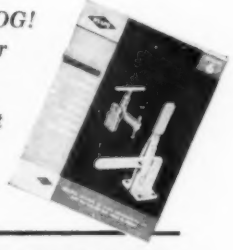
Toggle plier serves as low cost fixture for testing castings The air line is connected through one jaw of a Wespo Model 522 Toggle Plier. The plier is then clamped onto the casting and air applied by a foot control. Immersing the casting into a tank quickly spots any defects. Patented "Quick trigger" feature of the Model 522 instantly releases the casting; speeds testing. Rugged, lightweight Wespo toggle pliers are available in various jaw capacities and sizes.



Holding these glued parts together while drying is a simple task with Wespo Horizontal Bar-Type Toggle Clamps. Neoprene-capped spindles prevent damage to plastic surfaces, yet securely hold the parts during the drying operations. Wespo toggle clamps are available in more than 80 types and sizes. So, the next time you think clamps, think Wespo!

Simple, low cost "parking brake" for this track-operated frame is provided by a Wespo Push-Pull Clamp equipped with a neoprene-capped spindle. "Brake" is quickly applied or released by a simple flick of the wrist. Wespo Push-Pull Clamps are available in various sizes and holding pressures and are ordinarily used on holding fixtures where push or pull clamping is required.

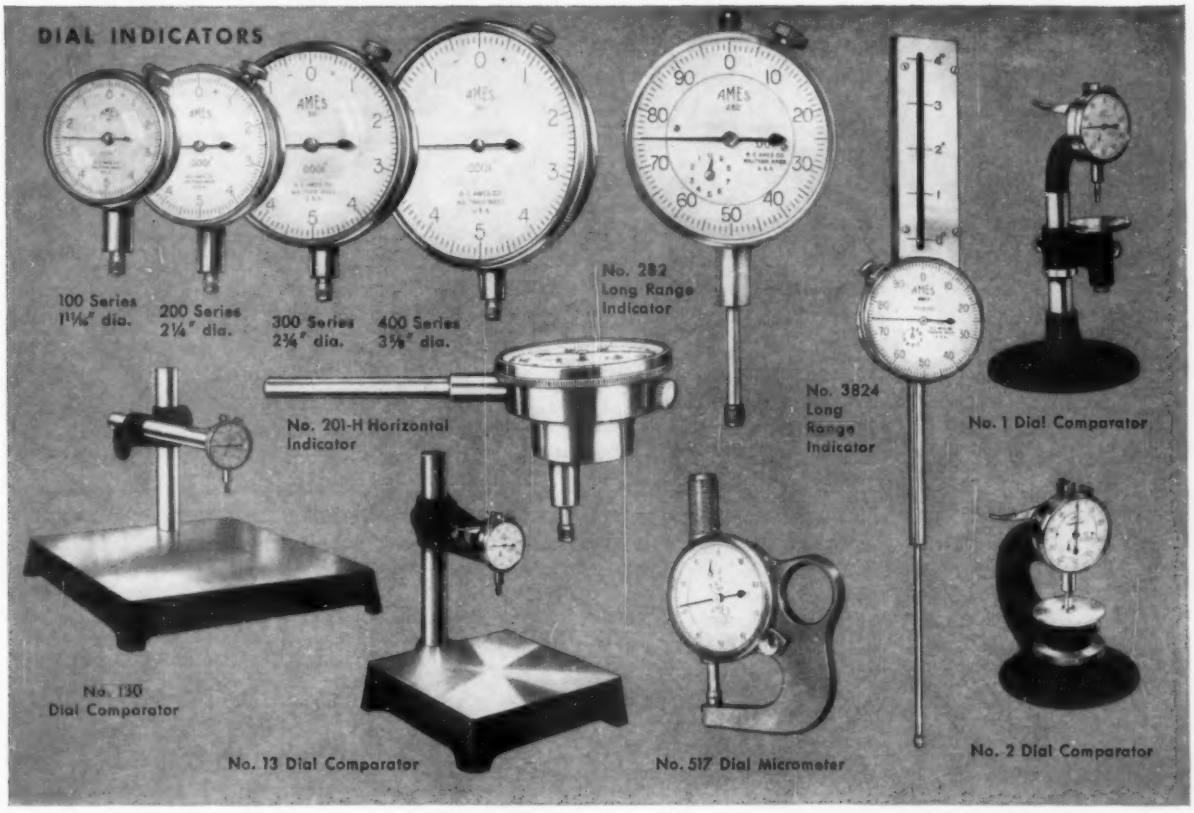
FREE CLAMP CATALOG!
Ask your Wespo distributor for your free copy of this 16-page Wespo catalog. It will help you quickly select the right clamp for every clamping job.



WESPO

DIVISION OF VLIER ENGINEERING CORPORATION
26935 W. Seven Mile Rd., Detroit 19, Michigan
Formerly West Point Manufacturing Company

AMES *Masters of Measurement*


DIAL INDICATORS
100 Series 1 1/16" dia.
200 Series 2 1/4" dia.
300 Series 2 3/4" dia.
400 Series 3 5/8" dia.
No. 282 Long Range Indicator
No. 201-H Horizontal Indicator
No. 3824 Long Range Indicator
No. 1 Dial Comparator
No. 130 Dial Comparator
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Use Them for Checking: taper, height, depth, flatness, roundness, straightness, thickness, diameter, length and size.

Features Include: easy-to-read dials, unbreakable crystals, forged cases, backs and wheel support, contour-lapped pinion teeth.

Attachments: rubber and metal dust guards, long stem indicators, tolerance hands, lift levers, special backs, contact points, etc.

For literally hundreds of measuring, indicating and comparing operations, you'll find Ames standard and customized gauges and indicators unerringly accurate and amazingly durable . . . *You're asking for the best when you specify Ames!*
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MANUFACTURERS OF MICROMETER DIAL INDICATORS, DIAL GAUGES, ACCU-FLOW AIR GAGES, PORTABLE TRANSISTORIZED COMPARATORS

HANDY & HARMAN SILVER BRAZING Permits Manufacturer to Guarantee Underwater Air Regulator For Life

Perhaps the most vital component of a skin diver's equipment, this Viking Air Regulator, manufactured by Christensen Tool & Engineering Company, Norwalk, Connecticut, is structurally guaranteed for life. It must, under all conditions, be absolutely leaktight. The manufacturer's guarantee is a relatively recent achievement—through the high-strength help of silver alloy brazing with Handy & Harman EASY-FLO 45 and HANDY FLUX.

Over and above the unreserved dependability of brazed joints, the brazing method itself has saved the company considerable time, money and material in the production of the Viking Air Regulator. Brazing's simplicity is interestingly illustrated in this case by this company's requirement that assemblers and testers of the Viking must be skin divers themselves.

Almost invariably, silver brazing effects economies and brings advantages to whatever part, product or assembly it is applied. True, air regulators are few and far between, but the point is that they are *metal products, made of a number of different metal components.*

And that's the phrase that covers brazing's great adaptability. To give you a good idea of how you can put brazing to work, we'd like to send you Bulletin 20—it covers the basics of brazing and it may very easily solve your metal-joining problems. Handy & Harman, 82 Fulton Street, New York 38, N. Y.

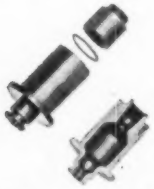
Here, in "serial" form is how the guarantee is "brazed" into the Viking:

1. TANK HOUSING—Initially, this component was mechanically joined and made "airtight" by means of sealants. Now, brazing eliminates 8 holes, 4 tapping operations, 4 screws and 3 assembly operations.

5. Shown here are the finished Viking components before and after assembling. —Brazing by Specialty Brazing Laboratories, Riverside, Connecticut.

3. YOKE—This is assembled from stampings instead of castings, which were previously used. With brazing, no secondary finishing operations are required. Further, the part is stronger and lighter, and savings on material and labor on this component alone add up to 28%.

2. FORK ASSEMBLY—There are five separate brazed joints, done with hand torch and hand-fed wire. Brazing eliminates one tapped hole, a lock washer and a spacer, plus the fact that positive alignment is now guaranteed.



4. PISTON—This is the most important single element of the Viking. It regulates flow of oxygen from cylinder to mouthpiece; from 300 lbs. pressure to normal breathing. Without brazing, this part could not be made.

Your No. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

DISTRIBUTORS IN PRINCIPAL CITIES

Atrax

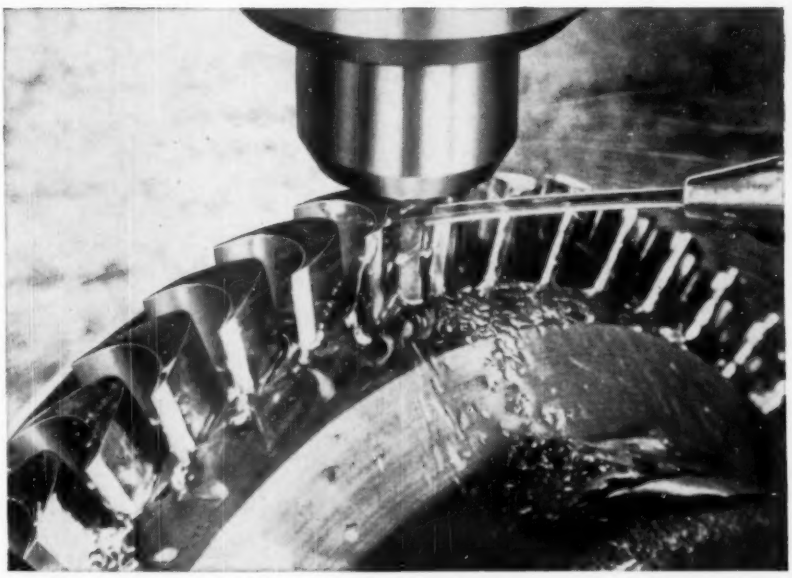
Precision Ground

SOLID CARBIDE TOOLS AND BURS

Job Applications

Solid carbide, 6 flute, ball nose, right hand spiral end mill .170" in diameter easily cuts rugged stainless steel alloy impeller buckets to close, uniform tolerances.

EXOTIC MATERIALS PROVE EFFICIENCY OF ATRAX SOLID CARBIDE END MILLS...



This Atrax end mill was produced as a special only to satisfy exacting tolerances on this extremely tough stainless steel alloy.

PRODUCTION UNIFORMITY

Milling cut was ½" deep. Work piece was held and rotated by means of a cam controlled fixture, the spindle and end mill were stationary. 42 buckets per impeller wheel had to be uniform in size, shape, weight and balance.

LONG TOOL LIFE ESSENTIAL

Because of the close tolerances required, end mills could not be resharpened so that maximum production without changing tool cutting characteristics was vital. Atrax end mills out-produced all others.

SIMILAR SUCCESS MILLING TITANIUM BUCKETS WITH 1/16" DIAMETER ATRAX END MILL!

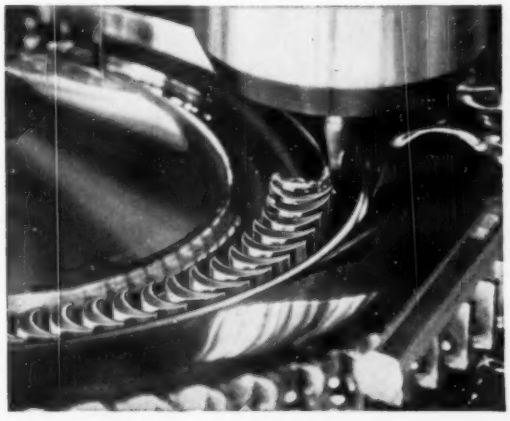


Photo shows a 1/16" diameter Atrax End Mill profiling to fine micro-finish buckets of a titanium turbine impeller. Each Atrax tool completed 72 buckets on each of 4 impeller wheels before replacement. The production performance proved far superior to high speed steel that deflected and broke under initial cut and competitive solid carbide end mill that produced profiling cuts on only 36 buckets before failure.

There's an Atrax Solid Carbide End Mill job engineered for virtually every end milling material and application.

Send for your copy of the 148 page Atrax Catalog.

THE ATRAX COMPANY

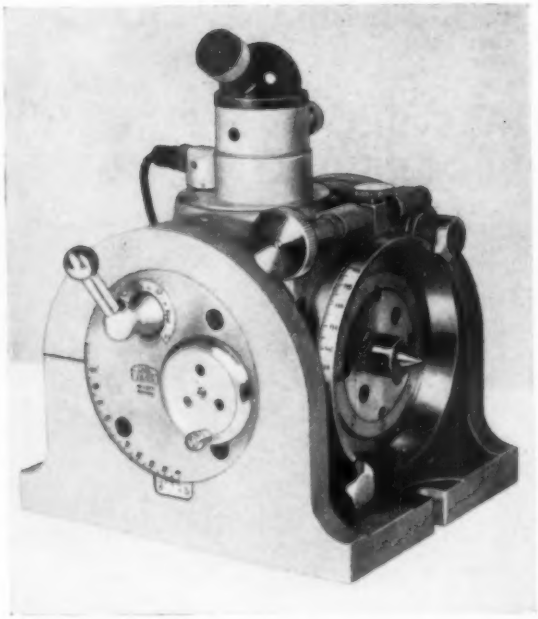
240 DAY STREET, NEWINGTON 11, CONN.

CARL ZEISS

Large and Small Optical Dividing Heads

Latest models that offer outstanding features

Made in West Germany

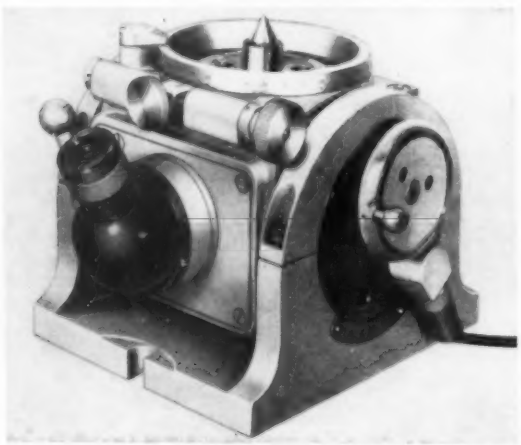


Large optical dividing head in horizontal position. Axis can be quickly changed to vertical.

The large optical dividing head is a universal testing and measuring instrument for circular scales and angles. It is used in high precision machining of cogwheels, slotted and perforated discs, graduated plates, spline shafts and similar production parts. Suitable for grinding, drilling, milling and other operations.

The instrument is also suitable in testing for graduation defects and for checking the measurements of angle-measuring instruments, levels, cam plates, etc.

FEATURES: Graduated glass circle, with 360° scale, is rigidly mounted on dividing head shaft, and is not affected by the transmission system for shaft rotation. . . . Microscope with 63x magnification for angle readings has inclined eyepiece with a head that can be rotated in all directions—insures convenient readings, independent of the inclination of the shaft axis. . . . Fine and coarse adjustments are gearless and mutually independent. . . . An external 360° scale permits rapid setting. Overall height: 370mm. Center height of spindle 130mm. Area of base: 310x250mm.



Small optical dividing head in vertical position.

THE SMALL HEAD

Designed especially for light machine tools in drilling, milling, grinding, etc., and its internal construction is the same as the large head. Its graduated glass circle is mounted on the dividing head shaft and is read with a 63x reading microscope. Has new antifriction bearings for main dividing head shaft. Controls—coarse adjustment, fine setting of angles—can be easily arranged to right or left. Overall height 250mm. Center height of spindle 90mm. Area of base: 220x180mm.

Write for literature

CARL ZEISS, INC.

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COMPLETE SERVICE FACILITIES

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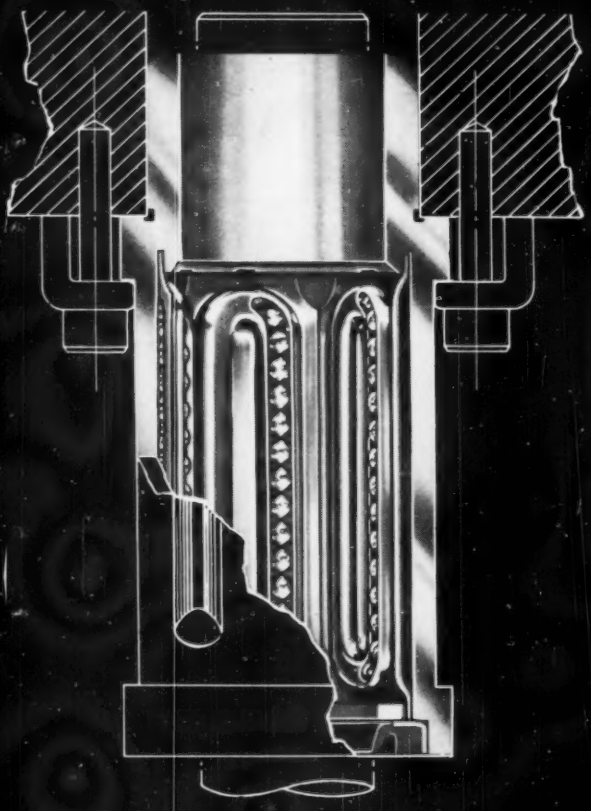
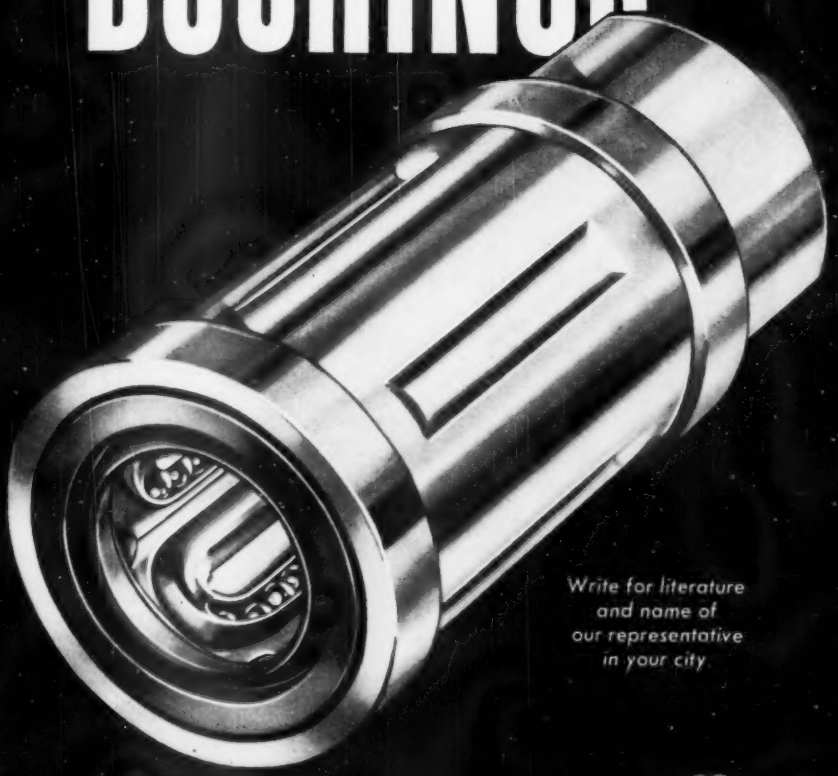


THOMSON INTERCHANGEABLE die-set BALL BUSHINGS®

NEW!

GO ANTI-FRICTION
with a simple bushing replacement
and (1) Improve performance of your *present* dies
and (2) Reduce tool room costs



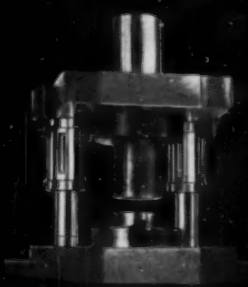
Write for literature and name of our representative in your city

in the PRESS ROOM

Ball Bushings allow closer fits and maintain alignment which increases die life and permits longer uninterrupted runs. Fewer sharpenings and sustained parts accuracy also result. Periodic lubrication is eliminated and higher speeds are possible. Unlimited travel permits die to be used in any press regardless of stroke. Costly smash-ups due to seizure are eliminated.

in the TOOL ROOM

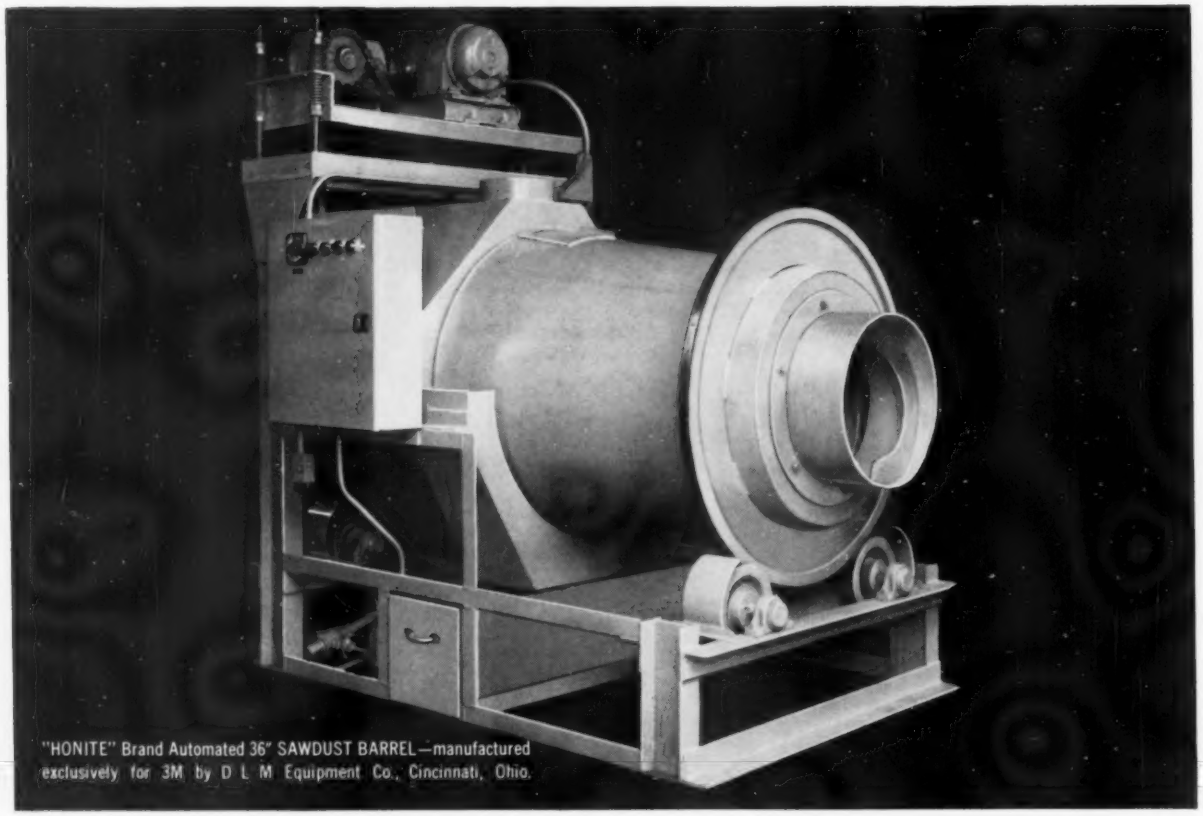
No cocking and binding . . . hence the punch holder "floats" on and off! No time consuming die jacking! Free-rolling *ball* bearings enable the toolmaker to actually "feel in" the fit of mating parts. This saves more time and makes better dies.



THOMSON INDUSTRIES, Inc.
Dept. D2, MANHASSET, NEW YORK

Makers of 60 Case hardened & ground shafting and NYLINED Bearings . . . Sleeve Bearings of DuPont NYLON

NEW FROM 3M



"HONITE" Brand Automated 36" SAWDUST BARREL—manufactured exclusively for 3M by D L M Equipment Co., Cincinnati, Ohio.

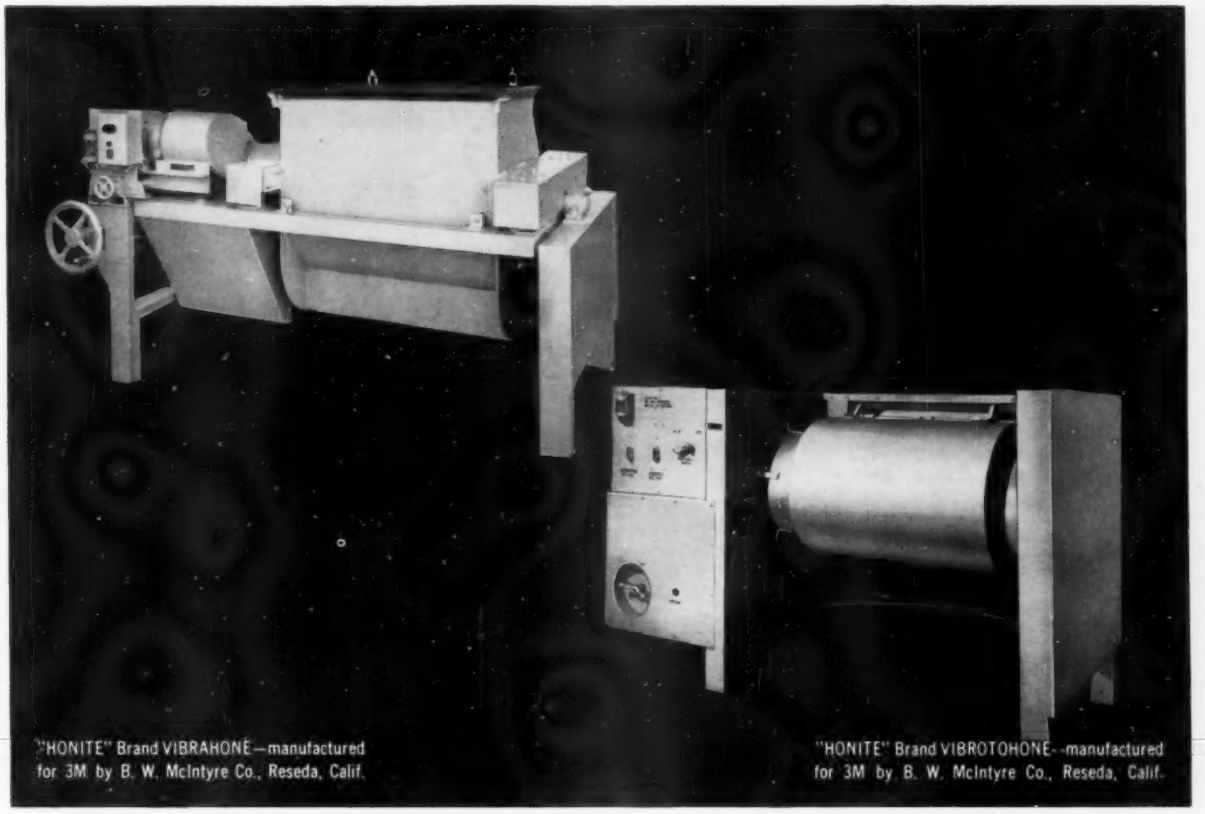
AT LAST, now from one source—3M—a complete line of "HONITE" Brand vibrating, rotating and automated barrel finishing equipment. Choose from more than 100 models, all embodying advanced engineering concepts to insure efficient, trouble-free operation.

AUTOMATED EQUIPMENT Your "HONITE" dealer has access to a completely new facility—one which provides semi-automated or completely automated barrel finishing equipment plus a custom-engineering service geared to plan and install entire systems of automation in your barrel finishing department.

"HONITE" automated equipment may be completely custom-built to suit your needs, or, in some instances your existing equipment may be automated. Standard "HONITE" automated equipment is also available, such as the 36" Sawdust Dryer pictured above. In its completely automated form, this machine performs loading, drying and polishing, media-part separation and unloading automatically.

"HONITE" AND "3M" ARE REGISTERED TRADEMARKS OF THE 3M CO., ST. PAUL 6, MINN.

. . . A COMPLETE LINE OF BARREL FINISHING EQUIPMENT



"HONITE" Brand VIBRAHONE—manufactured for 3M by B. W. McIntyre Co., Reseda, Calif.

"HONITE" Brand VIBROTOHONE—manufactured for 3M by B. W. McIntyre Co., Reseda, Calif.

VIBRATING EQUIPMENT

"HONITE" Brand vibratory equipment features two machines: VIBRAHONE, a tub type vibrator and VIBROTOHONE, a barrel type machine offering three distinct finishing actions —vibration, rotation, and vibration with rotation.

Unlike conventional vibrating equipment, these machines employ no springs but are supported by a revolutionary rubber-mount system. As a result more than 98% of the finishing force generated occurs within the barrel or tub. This is the most concentrated force in barrel finishing.

ROTATING EQUIPMENT

Choose from more than 92 models of the latest in barrel finishing machines—a wide variety of capacities and sizes.

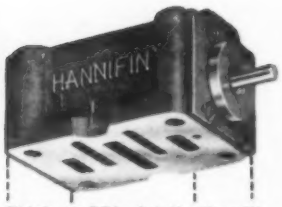
Why settle for partial service on your barrel finishing needs? Now you can get the machines, media and methods from one dependable source. For information or sample processing of your materials, contact your "HONITE" Field Engineer or distributor or write: 3M Co., "HONITE" Division, Dept. HAD-21. 900 Bush Ave., St. Paul 6, Minnesota.

Honite

MINNESOTA MINING AND MANUFACTURING COMPANY

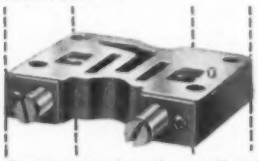
. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY



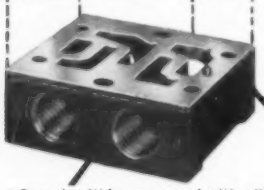
This basic CC body is the "heart" of every CC valve. Its one moving part is the "spool poppet", a Hannifin exclusive that seals bubble tight at either end of its short stroke. Note the ample air passages—all ¼" IPS or larger. This is single-actuator, spring return version.

This is the same body with double-end "spool poppet"—used when two actuators are required.



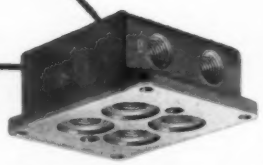
Speed control section, optional—designed to restrict exhaust flow, only, through either or both cylinder ports. Flow to the cylinder remains completely unrestricted through either port.

For foot-operated valves, the actuator is also the base, and this rear-ported adapter is used. Available tapped either ¼" or ⅜" IPS.



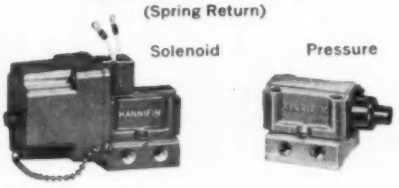
"Standard" base—used with all but foot-operated models. Every CC base is available tapped either ¼" or ⅜" IPS.

Optional base for "O" ring gasket mounting. Supplied complete with 4 O-rings.

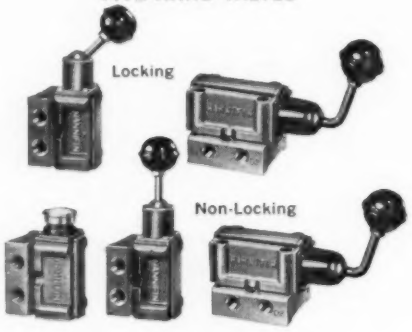


"Universal" base, tapped from beneath and from both sides. Four pipe plugs supplied. Can also be used with O-rings.

SINGLE ACTUATORS
(Spring Return)



FIVE HAND VALVES



TWO FOOT VALVES

TYPICAL COMBINATIONS
(Hundreds Available)

FOOT-OPERATED, LOCKING; PRESSURE OVER-RIDE —used on foundry machinery

CAM-OPERATED; PRESSURE-RETURN —used on automatic wash tanks

DOUBLE SOLENOID —used everywhere

PRESSURE-OPERATED; PRESSURE-RETURN —used everywhere

THESE QUICK-RESPONSE 4-WAY VALVES MOVE AIR DOWN THE LINE—FAST!

Hannifin CC valve design is the reason. Short, positive strokes of the "spool poppet" open up instant and ample passages for air.

Actuation? Any way you want it!

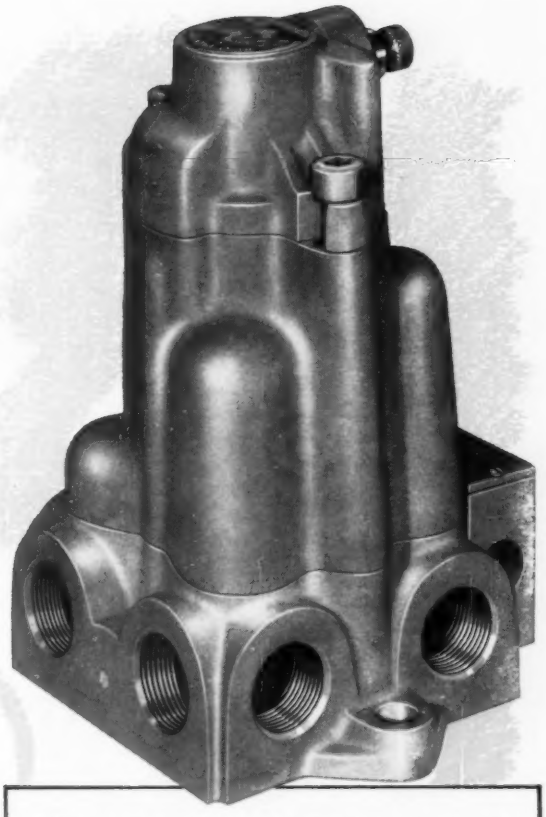
One basic body with a wide selection of operating heads and bases—all with or without our new speed control section—give you over 3,000 choices. We can help you make the right choice . . . through our field engineering service. Call your nearest Parker-Hannifin office or write us direct for full information.

HANNIFIN COMPANY
A DIVISION
519 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3138 PH.

It's new! HUNT ONE INCH PDQ VALVE

TOPS in accessibility
TOPS in simplicity
TOPS in speed
TOPS in capacity
TOPS in quality



Cylinder ports front, side and bottom-tapped; supply and exhaust ports side and bottom-tapped; basic 1 in. PDQ available tapped ¾, 1 or 1¼ in. NPT (also basic ½ in. PDQ tapped ⅜, ½ or ¾ in. NPT); for air or vacuum service, pressures from 0 to 125 psig; meets JIC Standards.

Now you can have all the performance-proved advantages of Hunt's PDQ center-line design PLUS the high capacity of full 1" size. The PDQ's short stroke pilot and compact, lightweight, single spindle poppet provide lightning-fast response and near-instantaneous full flow. All this in a compact package weighing only 10.8 pounds!

Look at these performance figures. The 1" PDQ, with 100 psig supply, fills a 400 cu. in. vessel to 90 psig in but 0.288 seconds (17.3 electrical cycles) . . . exhausts the same vessel from 100 to 10 psig in 0.200 seconds (12 electrical cycles) and, at 100 psig, its flow capacity is 850 cfm free air!

Downtime? Short stroke, shock-reducing all-aluminum construction and built-in wear compensation assure millions of cycles of trouble-free operation. Then, to repack, simply loosen 2 cap screws . . . twist pilot cap . . . remove pilot and valve housing. Piping is undisturbed . . . electrical connections are plug-in, wiring need not be touched.

If you're looking for better, lower cost, more dependable performance on new or existing equipment . . . before you buy any valve, be sure you see the PDQ. Call your nearby Hunt Representative today. He's listed in Sweet's Product Design File.

For more information, write for Bulletin 602. Address Dept. TE-261, Hunt Valve Company, Salem, Ohio.

HUNT

QUICK-AS-WINK® AIR AND HYDRAULIC VALVES

HUNT VALVE COMPANY • DIVISION OF IBEC • SALEM, OHIO

3014

Tests prove...40% greater wheel efficiency with SND selected natural diamonds

Lowest wheel cost and peak performance are assured — when you specify SND (Selected Natural Diamonds)—the most advanced development of diamond technology—for your diamond wheels. The superiority of SND (Selected Natural Diamonds) over man-made diamonds of comparative shape and size has now been proved indisputably by realistic carbide grinding tests under a broad range of job-use conditions *that apply in your own shop.*

Representative performance data—charted here from just one of the extensive test series—shows that SND-RB (Selected Natural Diamonds-Resinoid Bond) under this set of conditions performs with 40% greater grinding efficiency and greater freedom of cut than equivalent man-made RVG (Resinoid Vitrified Grit) diamond abrasive used in the same type of peripheral wheels.

This means that SND insures longer wheel life...greater wheel productivity...faster, cooler cutting in precision grinding. The results of other tests, conducted under varying conditions for both peripheral and flaring cup wheels, are equally important to you. A report of the test series will be sent to you gladly, on request.

Your diamond wheel supplier has the knowledge and experience to help you select SND Grit in wheels best suited to your particular requirements.

To keep up to date on latest developments in industrial diamond technology—including indisputable test results that prove SND superiority—write for technical bulletins.

GRIT TYPE AND SIZE	CROSS FEED	DOWN FEED	SPINDLE POWER CUT	GRINDING EFFICIENCY RATIO	COMPARATIVE EFFICIENCY
SND-RB (150)	.042"	.002"	690 Watts	32.3	140%
MAN-MADE RVG (150)	.042"	.002"	708 Watts	23.2	100%

PERFORMANCE RESULTS

Wet Grinding of Grade 44A with D1A1 Resinoid-Bond Wheels (5" x 3/16" x 1 1/4") at 4200 R.P.M.* Spindle Speed, 45 ft./min. Table Speed

**4200 R.P.M. Spindle speed simulates grinding with 6" peripheral wheels at 3600 R.P.M. (5500 S.F.M.)*

SND-RB (150) performs with 40% greater efficiency at lower spindle power... proof that this type of abrasive provides longer wheel life and faster, cooler cutting than equivalent man-made diamonds.

★ENGELHARD HANOVIA, INC.★
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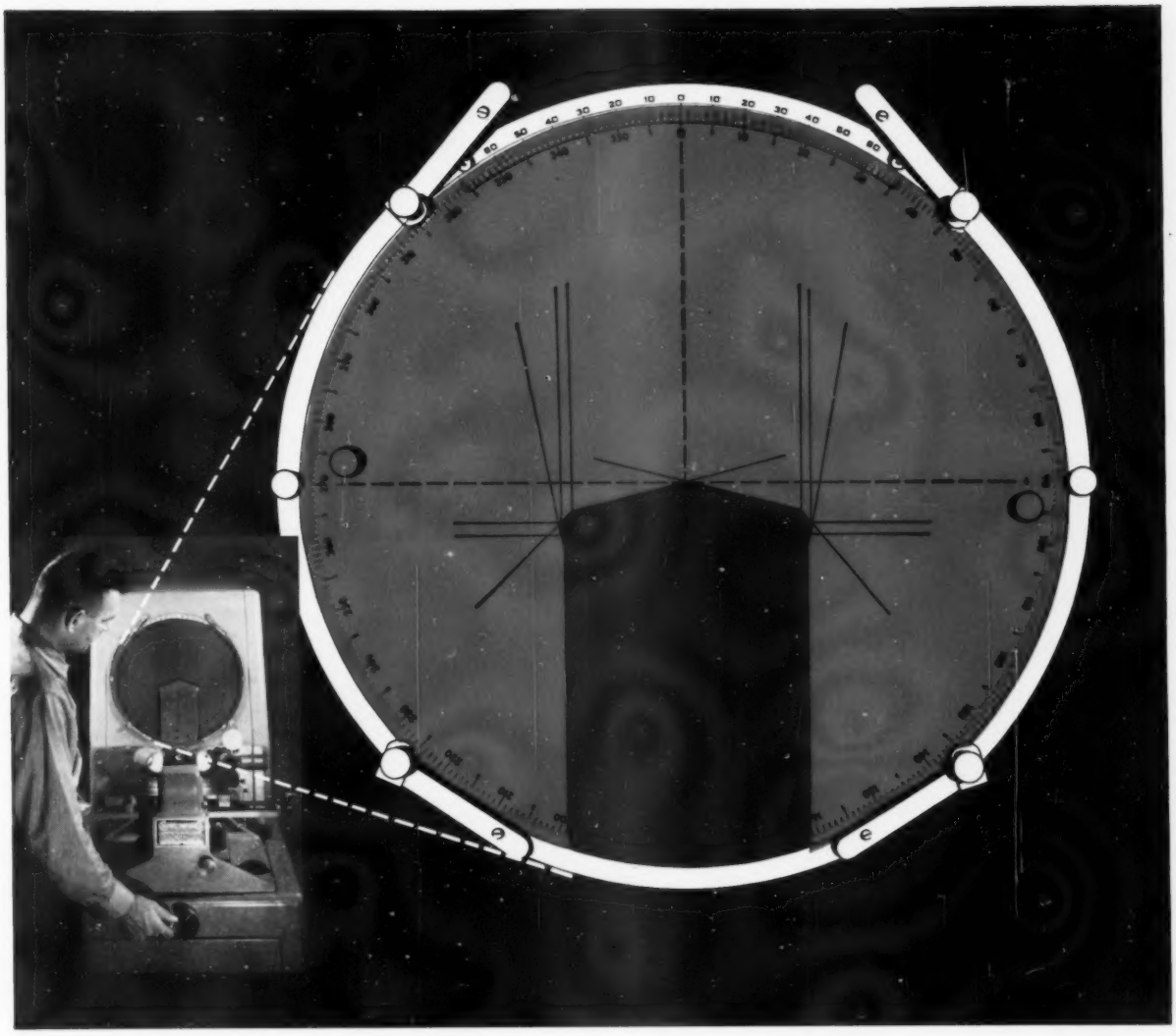

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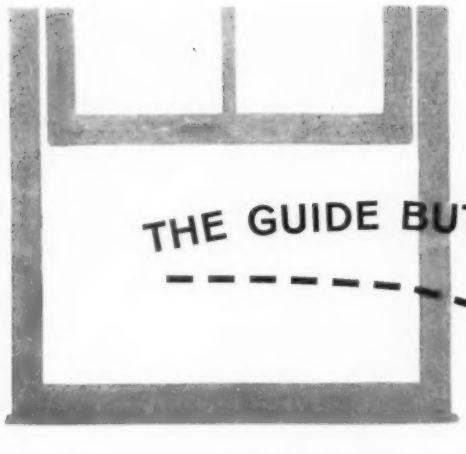

Wales STRIPPIT's new "BN" units have been designed for use *with or without* a guide button. Now, with this exclusive feature, only a punch and die (round or shaped) are required when you change from one hole size to another. For special applications and for optimum hole quality, the option of using a fitted or closed guide is still available.

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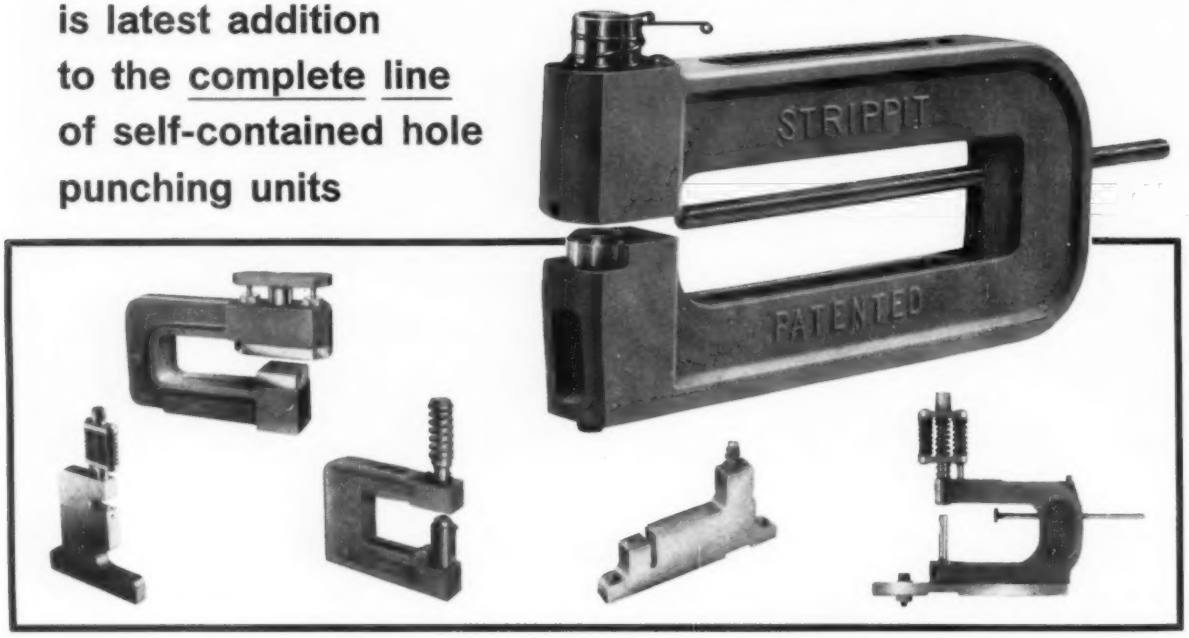
is latest addition to the complete line of self-contained hole punching units



Only STRIPPIT's "BN" units offer all these features:

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- New stripping guide slips out quickly and easily without taking off retainer clip.
- One-piece oil hardened tool steel punches.
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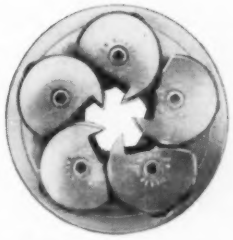

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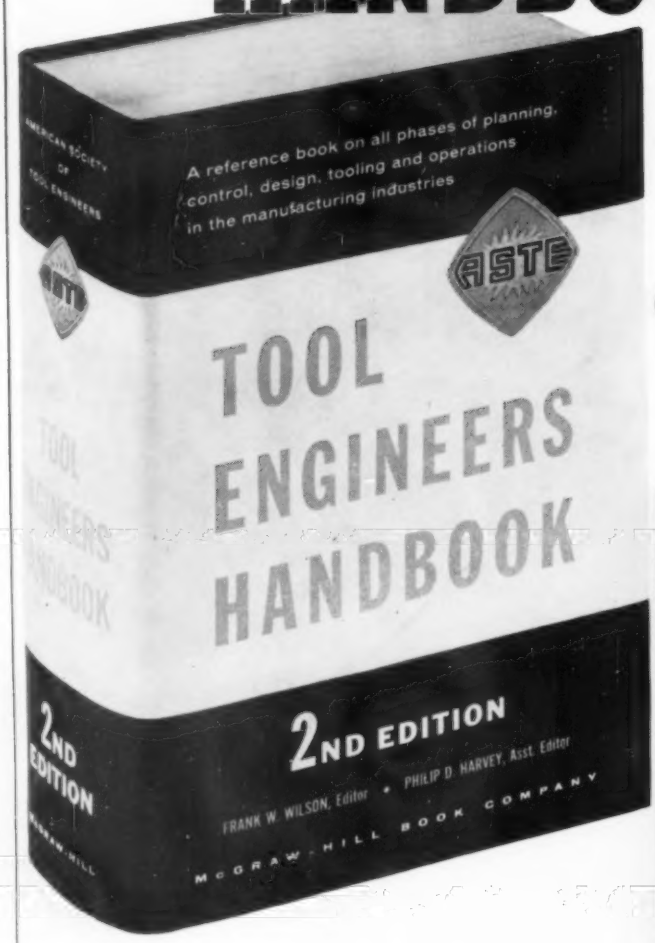
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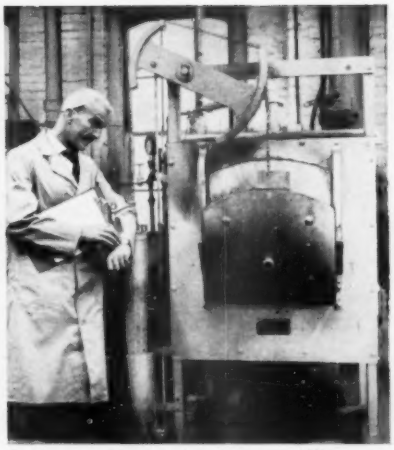

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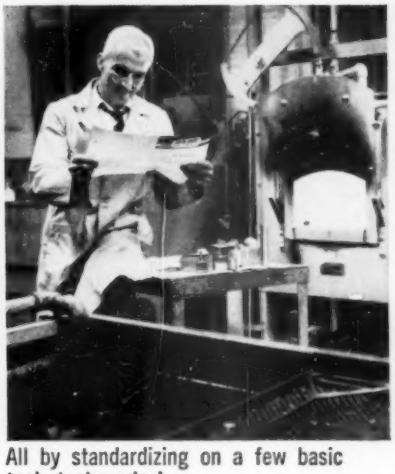

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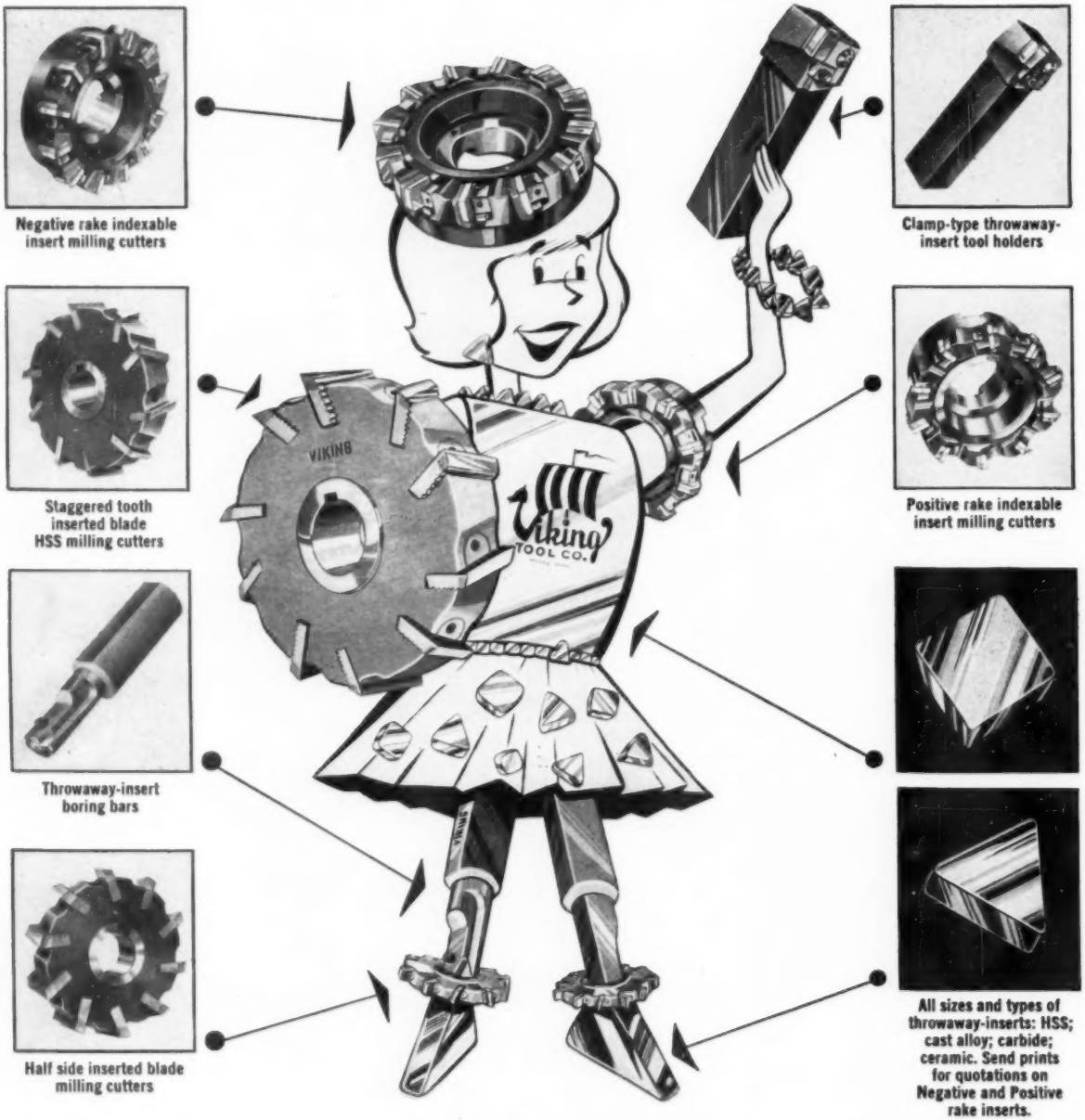

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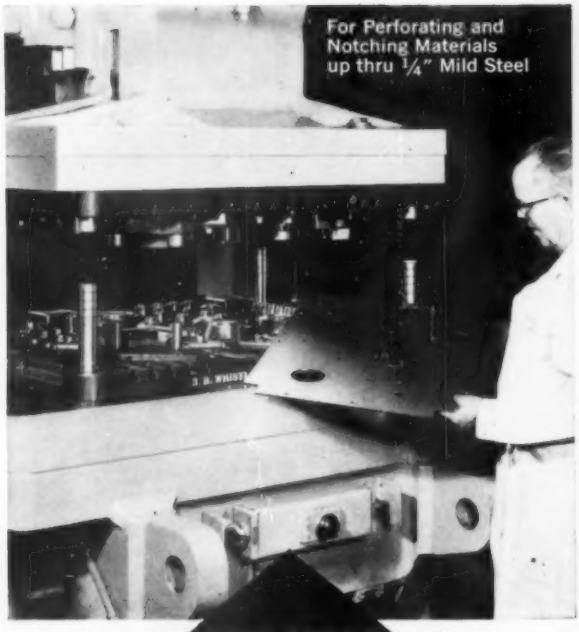

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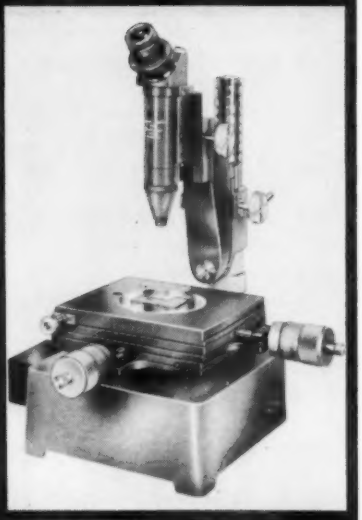

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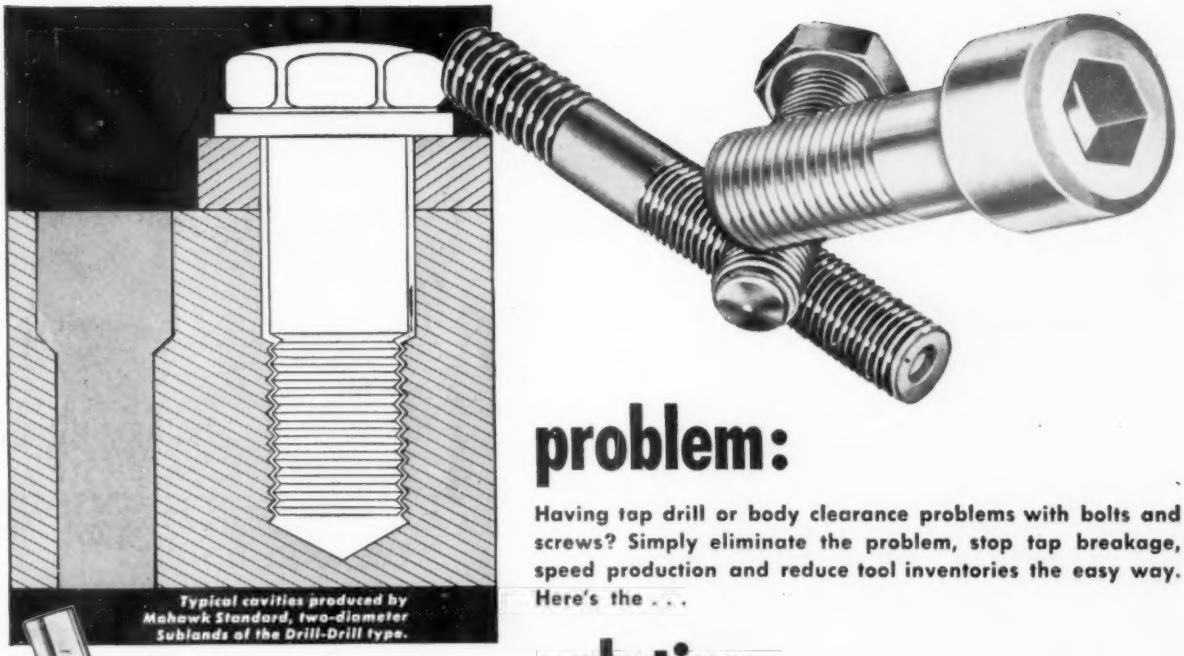

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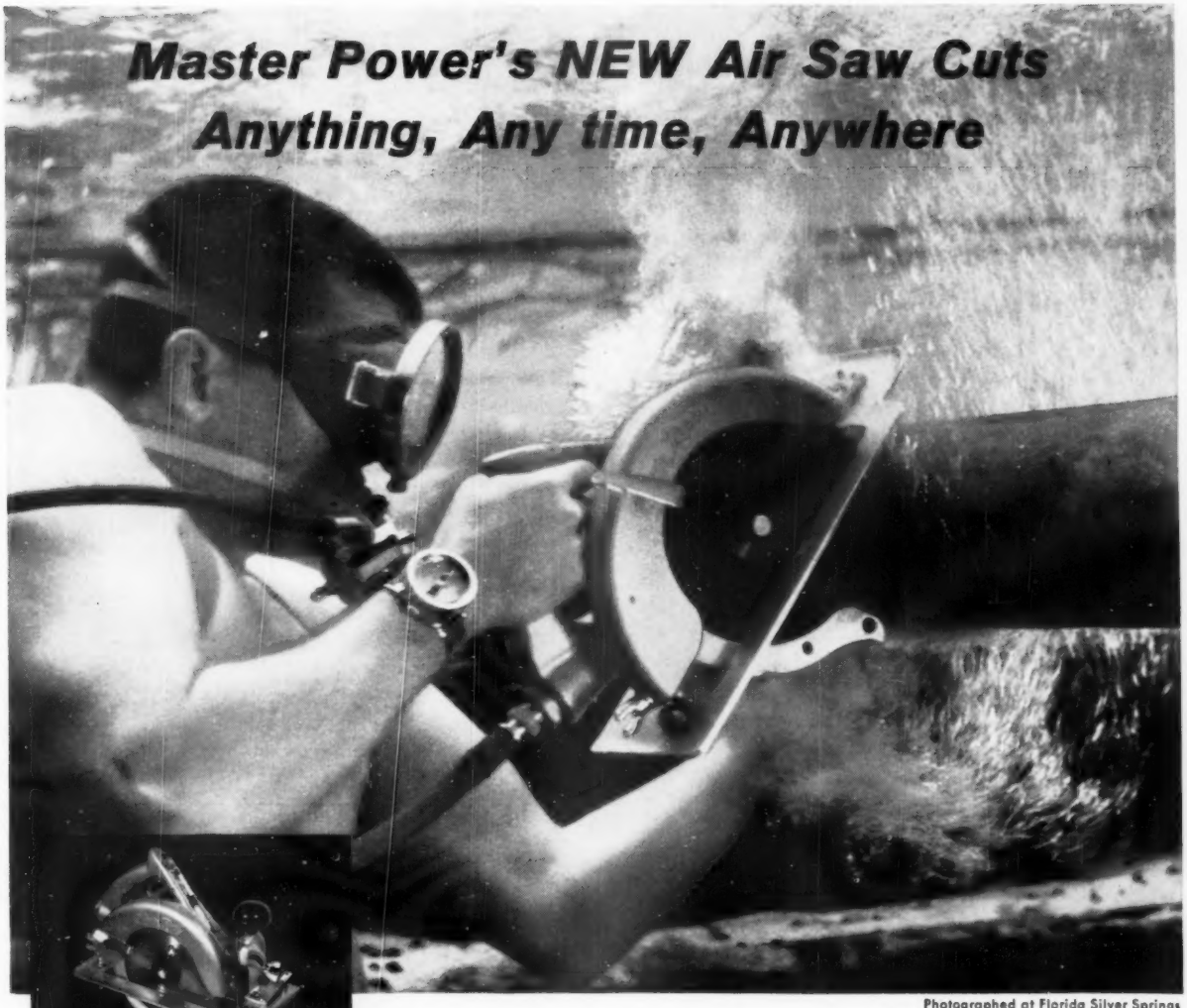

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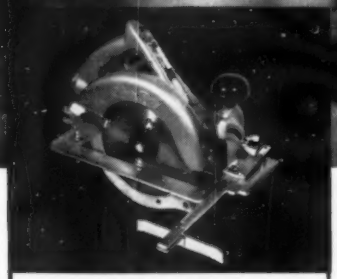

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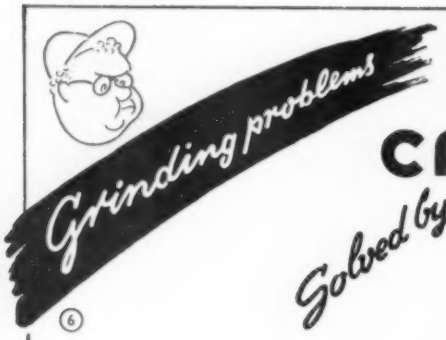

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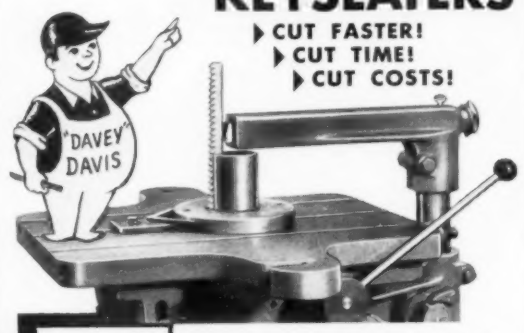

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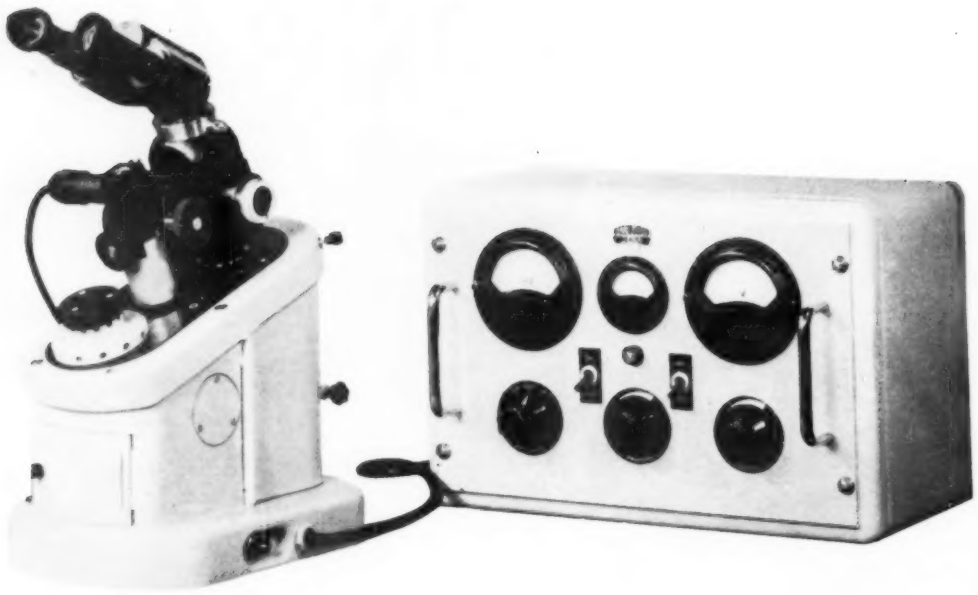

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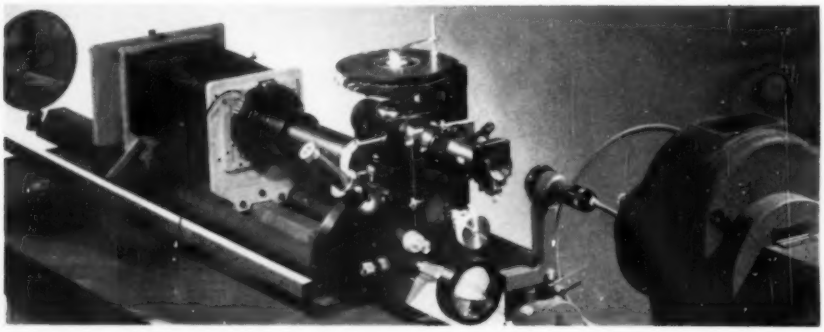

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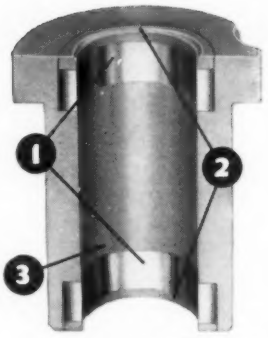

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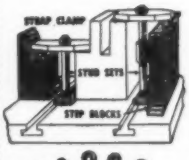

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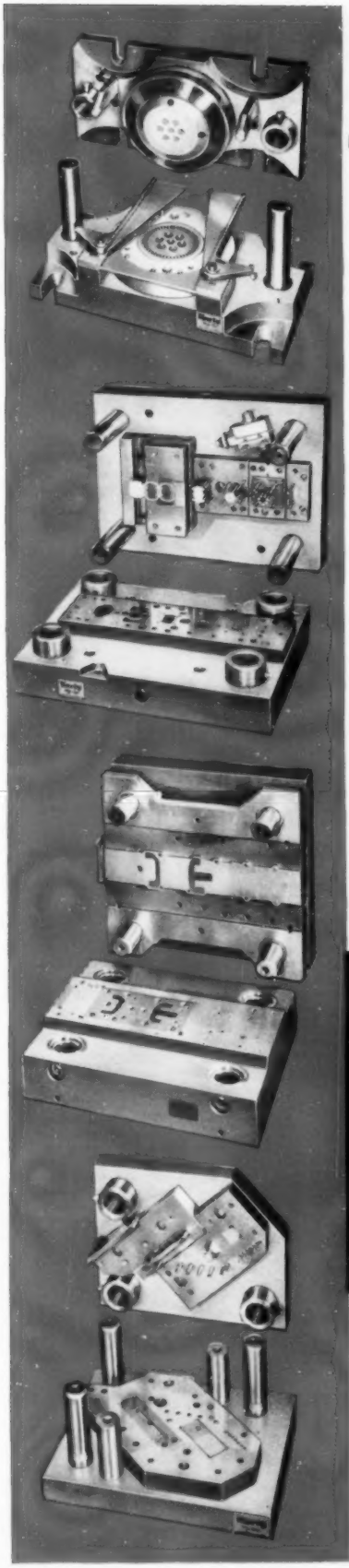

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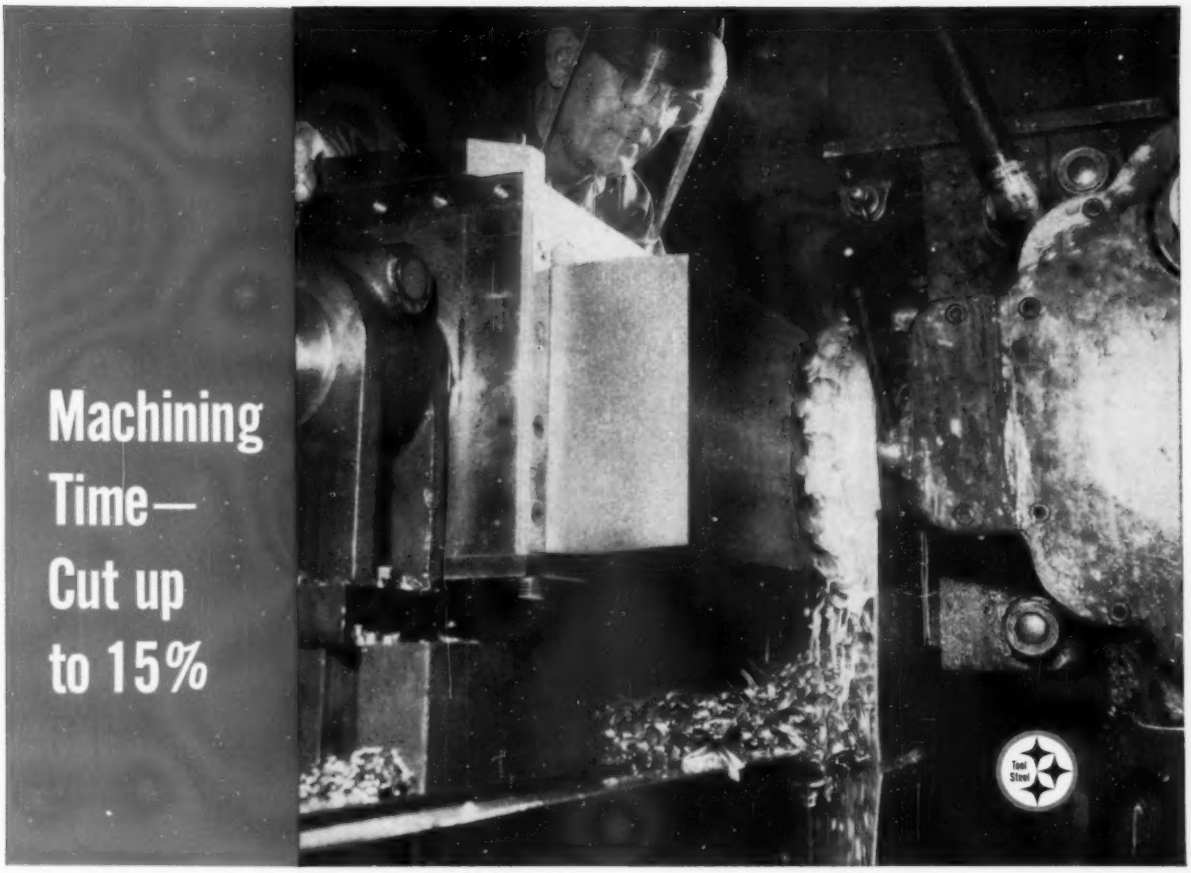

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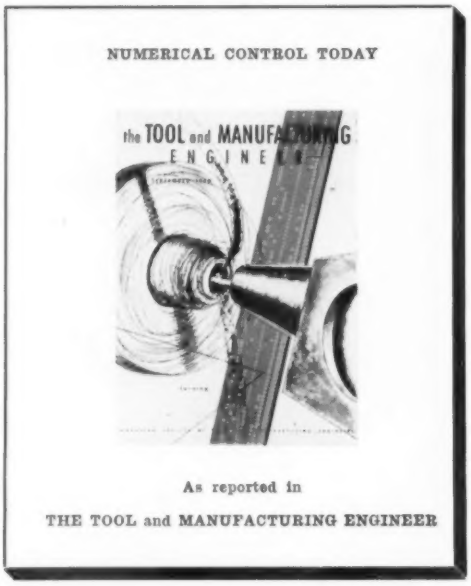

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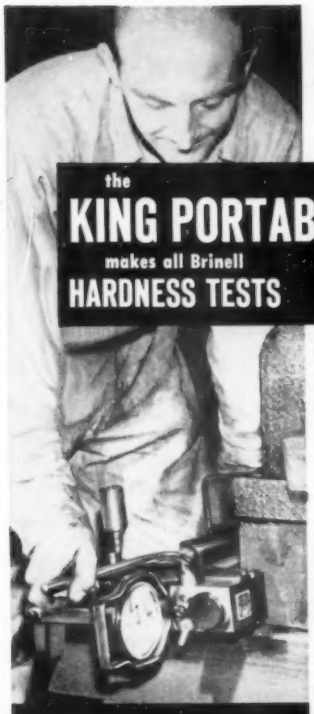

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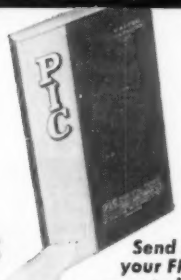

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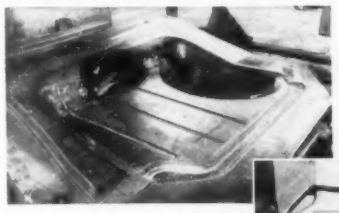
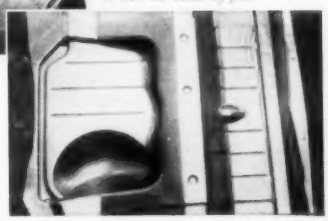


An epoxy-faced die used in drawing floor pans at Checker Motors Corporation, Kalamazoo, Mich. As many as 18,000 parts have been drawn using a die of this type.



Floor pan drawn by epoxy faced die (above). Checker has drawn up to 10 major body panels using epoxy dies.

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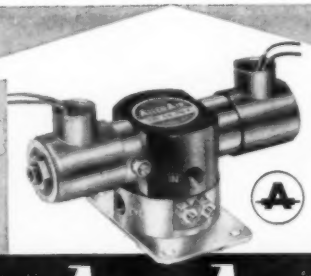

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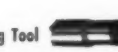
Old Hook Type Boring Tool  to the

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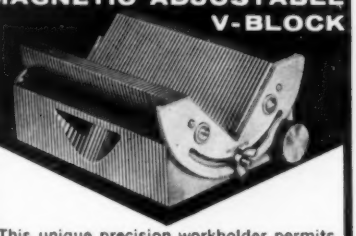

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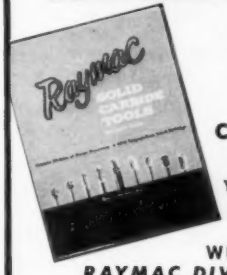

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February 1961

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CLEVELAND, 14	George J. Zavis, 1367 E. Sixth Street, Room 200, Lincoln Building	TOwer 1-0330
CHICAGO, 11	Stanley F. Girard, 612 North Michigan Avenue	MIchigan 2-4465
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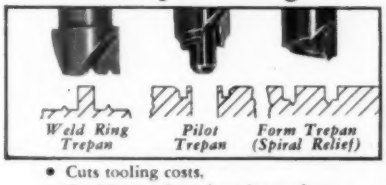

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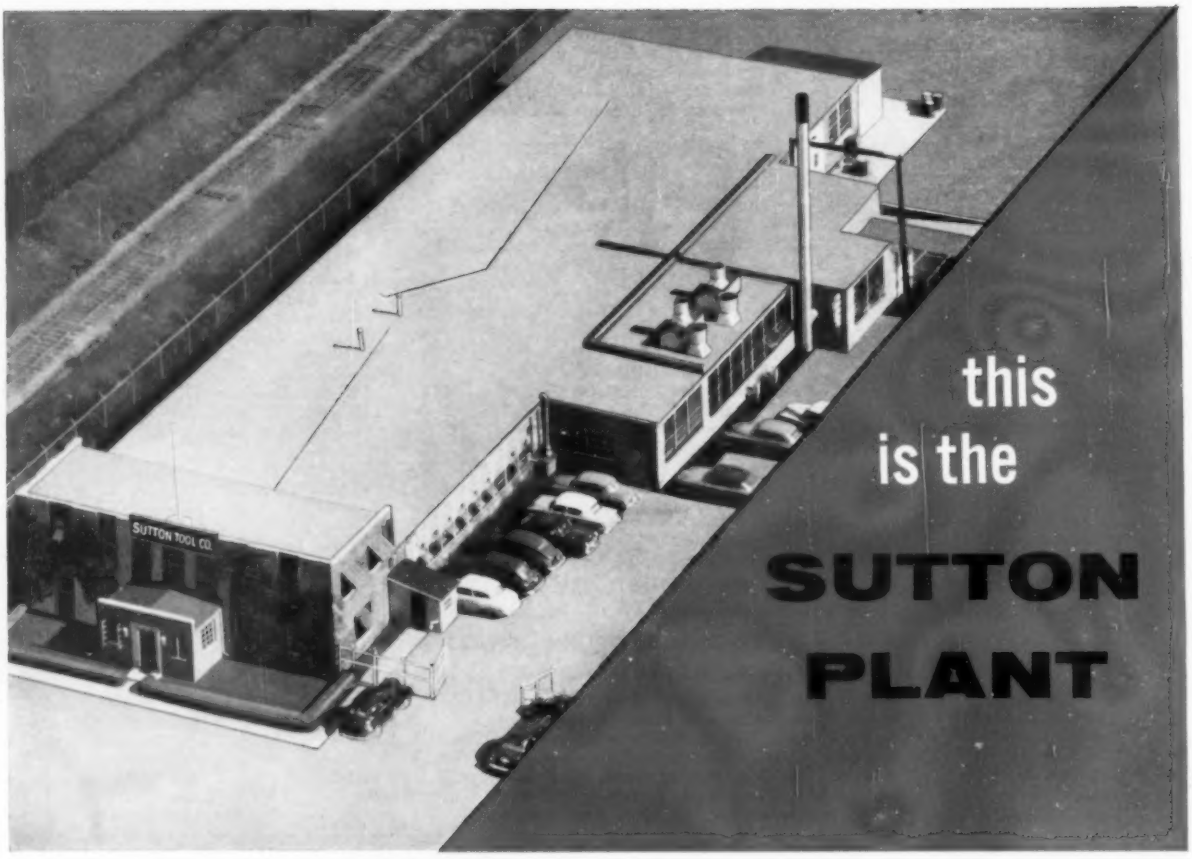

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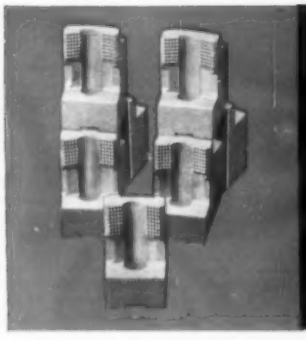

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- Expanding Mandrels
- Gear Hobbing Arbors
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Write for Tool Bulletin No. 70

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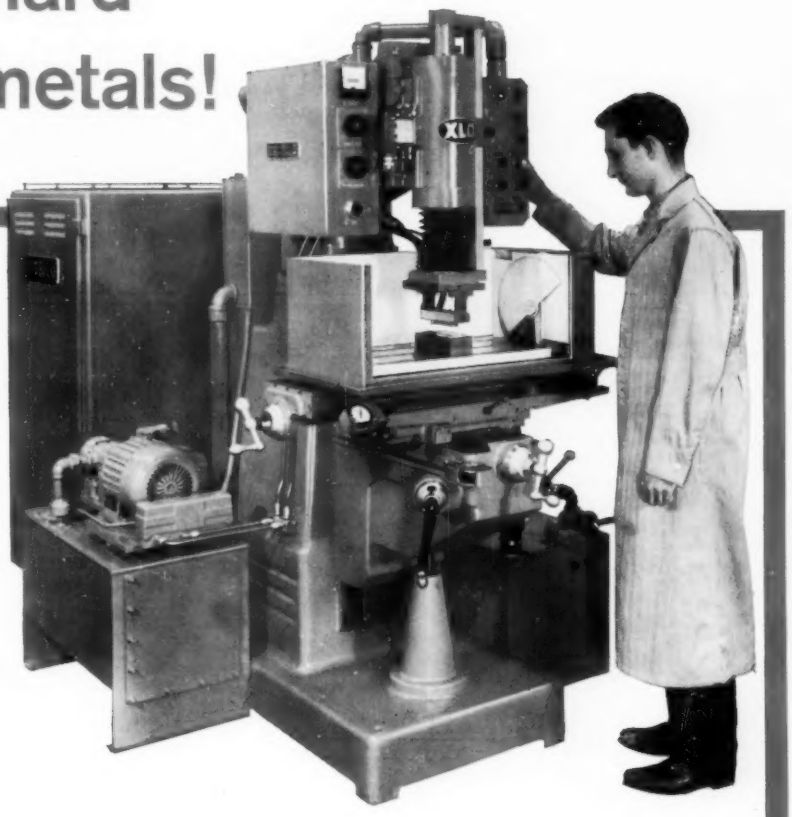
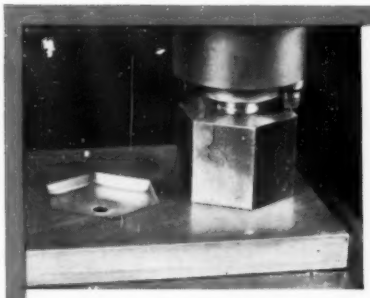
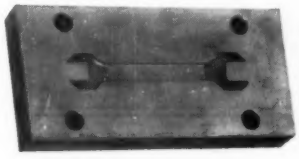




Lectra-Form produces an accurate, inverse image of the tool with a fine, uniform matte-type finish.



This wrench die was machined by Model 244 shown at right. Removable front panel of dielectric tank simplifies loading.

If the material you're working conducts electricity . . . you can drill, tap, pierce, trepan, slot or cut it, or sink intricate die cavities in it with LECTRA-FORM, the all-new Ex-Cell-O Vertical Electrospark Machine!

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60-79

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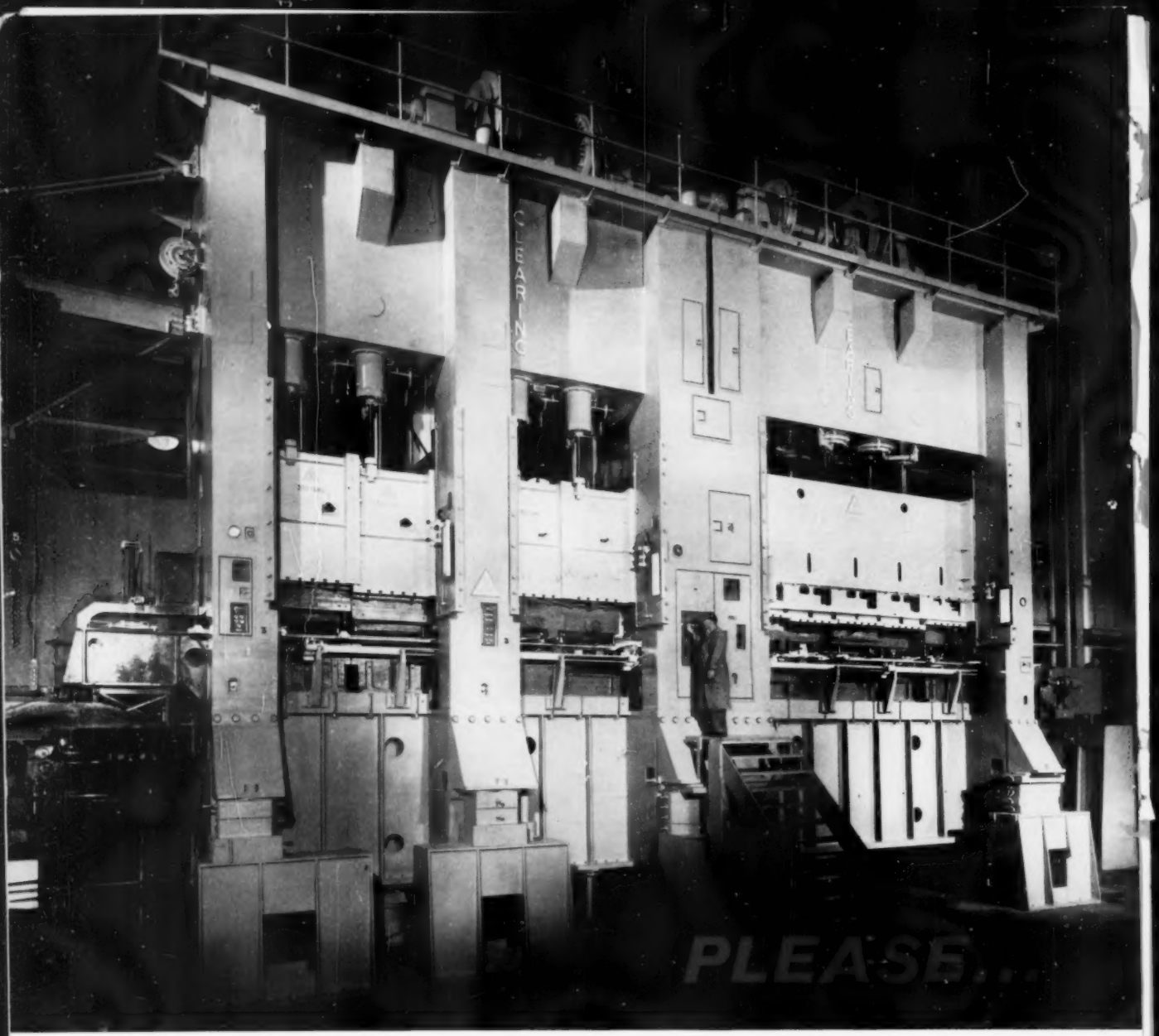

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(otherwise, we'll all be up to our ears in washing machines).

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